# The Society of Chemical Industry.

**Founded 1881. Incorporated by Royal Charter 1907.**

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|---|---|
| t. Hon. Sir Henry Roscoe, LL.D., F.R.S. | 1881—1882. |
| ir Frederick A. Abel, Bart., F.R.S. | 1882—1883. |
| falter Weldon, F.R.S. | 1883—1884. |
| t Wm. H. Perkin, LL.D., Ph.D., F.R.S. | 1884—1885. |
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| vid Howard | 1886—1887. |
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| ndwig Mond, Ph.D., F.R.S. | 1888—1889. |
| ir Lowthian Bell, Bart., F.R.S. | 1889—1890. |
| Rider Cook | 1890—1891. |
| Emerson Reynolds, M.D., D.Sc., F.R.S. | 1891—1892. |
| r John Evans, K.C.B., F.R.S. | 1892—1893. |
| C. C. Stanford | 1893—1894. |
| Edward Thorpe, C.B., LL.D., F.R.S. | 1894—1895. |
| mas Tyrer | 1895—1896. |
| ward Schunck, Ph.D., F.R.S. | 1896—1897. |
| nk Clowes, D.Sc. | 1897—1898. |
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| C. F. Chandler, D.Sc., M.D., Ph.D., LL.D. | 1899—1900. |
| †Sir Jos. W. Swan, D.Sc., M.A., F.R.S. | 1900—1901. |
| Ivan Levinstein | 1901—1902. |
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| Wm. H. Nichols, M.S., LL.D., D.Sc. | 1904—1905. |
| †Edward Divers, M.D., D.Sc., F.R.S. | 1905—1906 |
| †Eustace Carey | 1906—1907. |
| Sir Boverton Redwood, Bart., D.Sc. | 1907—1908. |
| Raphael Meldola, F.R.S. | 1908—1909. |
| Prof. Ira Remsen | 1909—1910 |
| Walter F. Reid | 1910—1911. |
| Rudolph Messel, Ph.D., F.R.S. | 1911—1912. |
| Marston T. Bogert, LL.D. | 1912—1913. |
| Sir William Crookes, O.M., Pres. R.S. | 1913. |
| Rudolph Messel, Ph.D., F.R.S. | 1914. |

† Deceased.

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Hugh Bell, Bart., 95, Sloane Street, London, S.W.
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Charles C. Carpenter, South Metropolitan Gas Co., 709, Old Kent Road, London, S.E.
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Richard Garton, Southampton Wharf, Battersea, S.W.
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ry Silvester, 78, Holyhead Road, Handsworth, Birmingham.

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. Coste, Utopia, Gloucester Road, Teddington.
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lloyd Howard, Uphall Works, Ilford, Essex.
harles A. Keane, 119, Ladbroke Road, London, W.
. Macdonald, Whitefriars, Rochester, Kent.
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ordon Salamon, 1, Fenchurch Avenue, London, E.C.
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tary .. T. D. Morson, 14, Elm Street, Gray's Inn Road, London, W.C.

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*Editor.*

T. F. Burton, 63, Melbury Gardens, West Wimbledon, S.W. (Telephone No. 1474 Wimbledon).

# LIST OF MEMBERS.

THE MEMBERSHIP ON FEBRUARY 28TH, 1915 = 3939.

NOTE: "O.M." MEANS ORIGINAL MEMBER.

## A

1912. Abady, Jacques, 1, Westminster Palace Gardens, London, S.W., and (Journals) 11, Lyndhurst Road, Hampstead, N.W., Barrister-at-Law, M.Inst.Mech.E.

1912. Abegg, Dr. Fritz, 28, Gordon Street, Perth Amboy, N.J., U.S.A., Chemist.

1903. Abraham, Herbert, 13, West 89th Street, New York City, U.S.A., Chemist.

1909 Acheson, Dr. Edward G., 5, Chancery Lane, London, W.C., President, Acheson Oildag Co.

1902. Acker, Chas. E., 80, Main Street, Ossining, N.Y., U.S.A., Manufactnrer.

1913. Acland, L. H. Dyke, 55, Comeragh Road, West Kensington, W., Analytical Chemist.

1903. Acton, J. Rowland, India Store Depôt, Belvedere Road, London, S.E., Civil Servant.

1911. Acton, Leonard T., c/o Wm. Davies Co., Ltd., 521, Front Street East, Toronto, Canada, Chemist.

1913. Acton, Walter, 9, Trees Park Avenne, Barrhead, Scotland, Works Manager and Chemist.

1912. Adam, G. H., "Lintrose," Malakoff Street, Marrickville, Sydney, N.S.W., Customs Analyst.

1914. Adam, N. K., South View, Cambridge Road, S. Farnborough, Hants, Chemist (Naval Air Service).

1907. Adam, Wm. A., o/o Mander Bros., Wolverhampton, Chemist.

1892. Adams, Arthur, Kelvin House, Edgbaston Road, Smethwick, near Birmingham, Science Lecturer.

1911. Adams, E. Bryan, c/o Curtis's and Harvey, Ltd., Explosives Works, Cliffe at Hoo, Kent, Chemist.

1897. Adams, Thos. H., 7, Douglas Street, Derby, Analyst.

1895. Adamson, G. P., The Baker and Adamson Chemical Co., Easton, Pa., U.S.A., Manufacturing Chemist.

1891. Adcock, S. R., St. Helens Smelting Co., Ltd., Atlas Court, St. Helens, Lancashire. Analytical Chemist.

1901. Addison, Leonard, Prince Regent's Wharf, Silvertown, Victoria Docks, E., Chemist.

1898. Adgate, M., Naugatuck, Conn., U.S.A., Chemist.

1913. Adkins, Linden R., 12, Fenwick Street, Rochester, N.Y., U.S.A., Oil Refinery Chemist.

1896. Adler, Dr. Leon N., Adler Colour and Chemical Works, 100, William Street, New York City, U.S.A., Manufacturing Chemist.

1907. Adley, Geo. S., Storer's Wharf, Poplar, London, E., Varnish Manufacturer.

1888. Adriance, Dr. John S., Williams College, Williamstown, Mass., U.S.A., Analytical Chemist.

1899. Adrot, Léon, 16, Palmer Avenue, Port Richmond, N.Y., U.S.A., Chemist.

1912. Aitken, James, c/o Pratt and Letchworth Co., Brantford, Ontario, Canada, Chemist.

1886. Aitken, J. B., Gerard's Fold Chemical Works, Widnes, Chemical Manufacturer.

1910. Aitken, Dr. J. M., St. Catherine, Bishopton, Renfrewshire, Chemist.

1912. Akers, Noel C., c/o A. J. Smith and Nephew, Ltd., Neptune Street, Hull, Manager-Chemist.

1883. Albright, G. S., Bromesberrow Place, Ledbury, Chemical Manufacturer.

O.M. Albright, W. A., 29, Frederick Road, Edgbaston, Birmingham, Chemical Manufacturer.

1906. Alcock, Frank H., 5, King Alfred's Place, Broad Street, Birmingham, Analyst.

1914. Alcock, W. J., c/o War Office, High Explosives Dept., Storey's Gate, Westminster, S.W., Alkali Works Manager.

1898. Alden, John, Chemical Laboratory, Pacific Mills, Lawrence, Mass., U.S.A., Chemist.

1909. Alén, Dr. J. E., Stadschemistens Laboratorium, Götebörg, Sweden, Public Analyst.

1899. Alexander, D. Basil W., 3814, Santa Fe Avenue, Los Angeles, Cal., U.S.A., Chief Chemist (General Petrolcum Co.).

1913. Alexander, Jas., 2208, Allendale Street, Walbrook, Baltimore, Md., U.S.A., Research Chemist.

1900. Alexander, Jerome, c/o National Gum and Mica Co., N.E. cor. 59th Street and 11th Avenne, New York City, U.S.A., Chemist.

1912. Alexander, Walter, National Gum and Mica Co., 59th Street and 11th Avenue, New York City, U.S.A., Secretary.

1883. Alexander, W. T., Crumnock, Eccles, Manchester, Drysalter.

1906. Allan, David, c/o Price's Patent Candle Co., Ltd., Bromborough Pool Works, near Birkenhead, Chemist.

1891. Allan, F. H. Tielke, c/o James S. Kirk and Co., Soap Works, Chicago, Ill., U.S.A., Technical Chemist.

1898. Allan, John, 77, Northen Grove, West Didsbury, Manchester, Chemist

1914. Allan, John L. S., c/o Wm. Wotherspoon, Ltd., Glenfield Starch Works, Paisley, Scotland, Analytical Chemist.

1909. Allan, Maurice, 103, Burford Road, Nottingham, Soapmaker.

1907. Allard, M. L., o/o Dunlop Tire and Rubber Goods Co., Toronto, Canada, Chemist.

1902. Allbright, Wm. B., 4937, Madison Avenue, Chicago, Ill., U.S.A., Chemical Engineer.

O.M. Alldred, C. H., 8, St. Margaret's Road, Plumstead Common, Woolwich, S.E., Technical Chemist.

1898. Allemsn, Dr. Gellert, Swarthmore College, Swarthmore, Pa., U.S.A., Professor of Chemistry.

1903. Allen, Chas. A., Overdale, Sunnyhurst, Darwen, Lancashire, Chemist.

1911. Allen, Harry L., 470, Morris Avenue, Elizabeth, N.J., U.S.A., Chemist.

O.M. Allen, J., 164, Upper North Street, Poplar, E., Manufacturing Chemist.

1893. Allerton, Rt. Hon. Lord, F.R.S., (Journals) Allerton Hall, near Leeds; and c/o W. L. Jackson and Sons Ltd., Buslingthorpe, Leeds, Tanner.

O.M. Allhusen, A., (Jnls.) W. Russell, Allhusen Works, Gateshead-on-Tyne, Chemical Manufacturer.

1886. Allibon, G. H., The Gables, Deramore Park, Belfast, Ireland, Chemical Works Manager.

1913. Allmand, Dr. A. J., Muspratt Laboratory, The University, Liverpool, Lecturer in Chemistry.

1905. Allpass, Jas., 9, Albert Square, Manchester, Secretary.

1912. Almy, Charles, c/o American Vulcanized Fibre Co., Wilmington, Del., U.S.A., Chemical Engineer.

1889. Alpiar, Agop, Morphia Manufacturer.

1899. Alsop, Wm. K., Ridgway, Pa., U.S.A., Chemist.

1910. Amin, Bhailal D., The Alembic Chemical Works Co., Ltd., Gorwo Road Camp, Baroda, India, Chemical Agent.

1905. Amory, L. H., c/o Messrs. J. Heathcoat and Co., Tiverton, Devon, Lace Manufacturer.

1914. Anders, H. R., Dept. F. of Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.

1914. Anderson, Albert E., c/o Procter and Gamble Co., Ivorydale, Ohio, U.S.A., General Superintendent.
1910. Anderson, Jas. R. V., School of Mines, Bendigo, Victoria, Australia, Lecturer in Chemistry and Metallurgy.
1900. Anderson, Jas. W., c/o The Thames Portland Cement Co., Ltd., Cliffe-at-Hoo, Kent, Analytical Chemist.
1914. Anderson, P. J., Marischal College, Aberdeen, Librarian.
1889. Anderson. Roht. T. R., 42, Roslea Drive, Dennistoun, Glasgow. Technical Chemist.
1894. Anderson, Dr. W. Carrick, 7, Scott Street, Garnet Hill, Glasgow, Consulting Chemist.
1905. Andreae, Dr. E. P., c/o British Glanzstoff Manufacturing Co.. Ltd., Flint, North Wales, Chemist.
1907. Andrews, Chas. T., 14a, Finsbury Square, London, E.C., Chemist.
1889. Andrews, Dr. Clement W., c/o The John Crerar Library, Wabash Avenue and Washington Street, Chicago, Ill., U.S.A., Librarian.
1912. Andrews, Ernest R., "Nutfield," Druce Road, Dulwich, S.E., Analytical and Consulting Chemist.
1914. Andrews, Joseph C., 123, Vine Street, New Britain, Conn., U.S.A., Chemical Engineer.
1903. Andrews, Wm. H., 79, Tonawanda Street, Buffalo, N.Y., U.S.A., Manager (Varnish Works).
1913. Andrews, W. O., P.O. Box 2671, Johannesburg, South Africa, Analytical Chemist.
1903. Anfilogoff, N. A., Thames Haven, Essex, Chemist and Petroleum Refiner.
O.M. Angell, J., 6, Beaconsfield, Derby Road, Withington, Manchester, Chemical Lecturer.
1913. Annan, J. G., Elm Cottage, Addiewell, Midlothian, Chief Chemist (Mineral Oil Works).
1892. Annandale, C. J. R., The Briary, Shotley Bridge, Co. Durham, Paper Maker.
1894. Ansbacher, L. A., 527, Fifth Avenue, New York City, U.S.A., Colour Manufacturer.
1913. Anspach, Dr. Richard, Lyckorna, Raynham Avenue, Didsbury, Manchester, Dyeworks Manager.
1902. Anthony, John, 217, King Street East, Toronto, Canada.
1900. Appleyard, Geo. H., 1, Carlton Terrace, Hornsea, East Yorks. Chemist.
1905. Appleyard, Jas. R., Royal Technical Institute, Salford, Lecturer.
O.M. Archbutt, Leonard, The Yews, Madeley Street, Derby, Analytical Chemist.
1899. Archdale, T. Henry, 38, Whitehirk, Blackburn, Manager of Tar and Ammonia Works.
1904. Archdale, Wm., Sandhutton, Hill Lane, Blackley, Manchester, Manager of Chemical Works.
1901. Ardagh, Prof. Edw. G. R., Faculty of Applied Science, University of Toronto, Canada, Chemist.
1900. Ardern, Edw., Holmleigh, Queen's Road, Urmston, Manchester, Chemist.
1907. Armstrong, Chas. F., c/o Cawnpore Sugar Works, Ltd., Marhowrah Factory P.O., Chapra, Saran, India, Technical Chemist.
1902. Armstrong, Edward E., Pennsylvania Salt Manufacturing Co., Natrona, Pa., U.S.A., Manufacturing Chemist.
1905. Armstrong, Dr. E. Frankland, c/o J. Crosfield and Sons, Ltd., Warrington, Technical Chemist.
1912. Armstrong, Prof. H. E., F.R.S., 55, Granville Park, Lewisham, S.E., Consulting Chemist.
1899. Armstrong, Richard, Saul Street Soap Works, Preston, Lancashire, Soap Manufacturer.
1905. Arnold, Frank L., 32, School Street, North Woburn, Mass., U.S.A., Chemist.
1899. Arnott, Dr. G. W. Campbell, c/o Fertiliser Manufacturers' Association, 63-70, Fenchurch Street, London, E.C., Agricultural Chemist.
1903. Arnott, J. S., Moros, 42, 2°, Gijon, Spain, Chemist and Metallurgist.
1912. Arny, H. V., 115, West 68th Street, New York City, U.S.A., Teacher and Chemist.
1911. Asahina, Koju, Uyeda Sericulture College, Uyeda, Shinano, Japan, Chemist.
1901. Asano, K., Ashio Copper Mine, Shimozuke, Japan, Consulting Mining Chemist.
1908. Ashbury, J. W., c/o John Brown and Co., Ltd., Laboratory, Atlas Works, Sheffield, Chief Chemist.
1914. Ashcroft, Edgar A., Research Laboratory, North Weald, Essex, Technical Chemist.
1903. Ashley, Frank R., c/o Western Chemical Manufacturing Co., Denver, Colo., U.S.A., Manufacturing Chemist.
1890. Ashton-Bost, W. D. *See* Bost, W. D. Ashton.
1894. Ashworth, Arthur, Fernhill Chemical Works, Bury, Lancs., Chemical Manufacturer.
1908. Ashworth, D. Irving, P.O. Box 503, Wappingers Falls, N.Y., U.S.A., Chemist.
1907. Aspey, Urban, jun., New Station Soap Works, School Close, and (Journals) 11, Neville Street, Leeds, Works Manager and Chemist.
1898. Aspinall, Thos., 34, Chorley New Road, Bolton, Analytical and Manufacturing Chemist.
1900. Aston, Bernard C., Box 40, P.O., Wellington, New Zealand, Chemist.
1891. Atkins, C. E., The Heath, Redbourn, Herts., Chronometer Maker.
1885. Atkinson, A. J., 10, North Church Street, Cardiff, Analytical Chemist.
1912. Atkinson, F. C., c/o American Homing Co., Gent Avenue, Indianapolis, Ind., U.S.A., Chemist.
1911. Atkinson, James E., The Sheffield Testing Works, Ltd., Blonk Street, Sheffield, Analytical Chemist.
1900. Atkinson, Jno. W., Betteravia, Santa Barbara Co., Cal., U.S.A., Manager, Union Sugar Co.
1915. Atack, F. W., 88, Claude Road, Choriltonville, Manchester, Demonstrator in Chemistry.
1905. Atteaux, F. E., 176, Purchase Street, Boston, Mass., U.S.A., Dyestuff Importer.
1900. Atwood, Frank W., 216, Milk Street, Boston, Mass., U.S.A., Chemist.
1895. Auchterlonie, Wm., c/o Clark Thread Co., Newark, N.J., U.S.A., Dyeworks Manager.
1897. Auger, Chas. L., 425, Park Avenue, Paterson, N.J. U.S.A., Silk Dyer.
1911. Austin, Fred. J., 343, Sixth Avenue, Brooklyn, N.Y. U.S.A., Chemist.
1913. Austin, Wm. L., 113, Church Lane, Charlton, S.E. Analytical Chemist.
1901. Auty, Albert M., c/o John Smith and Sons, Ltd. Field Head Mills, Bradford, Works Chemist.
1902. Avery, D., 387, Barker's Road, Kew, Melbourne, Vic., Australia, Teacher of Chemistry.
1910. Ayers, Gilbert F., Dynamite Factory, Modderfontein, Transvaal, Chemist.
1899. Aylsworth, Jonas W., 223, Midland Avenue, East Orange, N.J., U.S.A., Chemist.

## B

1908. Babington, Fred. W., Customs Laby., Customs Dept., Ottawa, Canada, Analyst.
1913. Backus, Cecil F., c/o Atlas Powder Co., Wilmington, Del., U.S.A., Chemist.
1913. Bacon, Raymond F., Mellon Institute of Industrial Research, The University, Pittsburgh, Pa., U.S.A., Associate Director.
1911. Baddiley, James, c/o Levinstein, Ltd., Crumpsall Vale Chemical Works, Blackley, Manchester, Research Chemist.
1897. Badock, Stanley H., Holmwood, Westbury on Trym, near Bristol, Smelter.
1898. Baekeland, Dr. Leo, Snug Rock, Harmony Park, Yonkers, N.Y., U.S.A., Research Chemist.
1912. Bagley, Fred. P., c/o George H. Morrill Co., Norwood, Mass., U.S.A., Ink Manufacturer.
1913. Bailey, Alan M., Winchester House, Singapore, S.S., Analytical Chemist.

1903. Bailey, Prof. E. H. S., The Library, Kansas State University, Lawrence, Kas., U.S.A., Professor of Chemistry.
1885. Bailey, Edwin M., Almond Hill, Pumpherston, Mid Calder, Scotland, Technical Chemist.
1908. Bailey, Frank W., 25, Lord Street, Glossop, Derbyshire.
1883. Bailey, Dr. G. H., Kinlochleven, Argyll, Scotland, Chemist.
1903. Bailey, Harold J., 10, Park Road, Pendleton, Manchester, Alkali Inspector.
1906. Bailey, Ralph W., 66, Cherry Street, Elizabeth, N.J., U.S.A., Chemist.
1888. Bailey, Dr. T. Lewis, 21, Shavington Avenue, Chester, H.M. Inspector of Alkali Works.
1910. Baillie, Dr. Thomas B., 5, Mossgiel Avenue, Ainsdale, Lancashire, Analytical Chemist (Love Lane Sugar Refinery).
1902. Bain, Prof. Jas. Watson, Faculty of Applied Science, The University, Toronto, Ont., Canada, Chemist.
1911. Bainbridge, Edmund F., c/o American Alkali and Acid Co., Bradford, Pa., U.S.A., Chief Chemist.
1911. Baird, Douglas H., 14, Cross Street, Hatton Garden, London, E.C., Scientific Instrument Maker.
1908. Baird, M. M., 18, Jedburgh Avenue, Rutherglen, Glasgow, Analytical Chemist.
1891. Baird, Wm., c/o Lewis Berger and Sons, Ltd., Homerton, N.E., Technical Chemist.
1895. Baird, W. Raymond, 271, Broadway, New York City, U.S.A., Patent Lawyer.
1890. Bairstow, John, Burley, Queen's Park, Chester, Chemical Works Manager.
1903. Baker, Arthur, Mount Nod, Greenhithe, Kent, Chemist.
1913. Baker, Bertram F., Oak Villa, New Chester Road, Cheshire, Technical Chemist.
1902. Baker, Chas. F., Technical College, Sunderland, Lecturer in Chemistry.
1910. Baker, C. Kerslake, 16, Change Alley, Sheffield, Analytical Chemist.
1901. Baker, F. Guy Stirling, The Brewery, Chiswell Street, London, E.C., Brewer's Chemist.
1883. Baker, Harry, Epworth House, Moughland Lane, Runcorn, Analytical Chemist.
1904. Baker, John T., c/o J. T. Baker Chemical Co., Phillipsburg, N.J., U.S.A., Manufacturing Chemist.
1892. Baker, Julian L., Ardingley, Linden Avenue, Maidenhead, Brewing and Sugar Chemist.
1909. Baker, Robert P., Ivydene, Bexley, Kent, Technical Chemist.
1886. Baker, Theodore, 705, Du Pont Building, Wilmington, Del., U.S.A., Analytical Chemist.
1910. Baker, Dr. Thos., Westville, Doncaster Road, Rotherham, Chemist and Metallurgist.
1912. Balch, Prof. Alfred W., 416, Huntington Avenue, Boston, Mass., U.S.A., Professor of Biological Chemistry.
1914. Balcon, P. C., c/o Power Gas Corporation, Ltd., Stockton-on-Tees, Chemist.
1912. Baldracco, Cav. Prof. Dr. Giacinto, R. Conceria Scuola Italiana, Corso Cirie, ang. Via Biella, Turin, Italy, Leather Trades Chemist.
1903. Baldwin, F. H., Bergenport Chemical Works, Bayonne, N.J., U.S.A., Superintendent.
1903. Baldwin, Dr. H. B., 927, Broad Street, Newark, N.J., U.S.A., Chemist (Dept. of Public Health).
1903. Ball, S. F., 289, East 201st Street, New York City, U.S.A., Analytical Chemist.
1889. Ballantyne, Horatio, 75, Chancery Lane, London, W.C., Analytical and Consulting Chemist.
1903. Ballantyne, W. H., 111, Hatton Garden, London, E.C. Patent Agent's Assistant.
O.M. Bellard, Edw. G., 8, Lansdowne House, Lansdowne Road, Holland Park, London, W., Alkali Works Inspector.
1915. Balmforth, Charles, 68, Thompson Street, Shipley, Yorkshire, Analytical Chemist.
1910. Baly, Prof. E. C. C., F.R.S., 14, Sunnyside, Prince's Park, Liverpool, Professor of Inorganic Chemistry,
O.M. Bamber, H. Kelway, Ontram House, Addiscombe, Surrey, Consulting Chemist.
1894. Bamber, H. K. G., Ingress House, Greenhithe, Kent, Cement Works Manager.
1898. Bamford, Harry, 70, Duckworth Terrace, Bradford, Yorks, Dyer.
1906. Bancroft, John, Wilmington, Del., U.S.A., Bleacher and Dyer.
1913. Banks, A. J., c/o The Ogilvie Flour Mills Co., Ltd., Montreal, Canada, Analyst.
1890. Banks, Jno. H., 80, Maiden Lane, New York City, U.S.A., Mining Engineer.
O.M. Bannister, W., Dunloe, Bramley Hill, South Croydon, Manufacturing Chemist.
1910. Barbary, J. Ewart, "Vellansaundry," Camborne, Cornwall, Explosives Chemist.
1909. Barber, C. Douglas, Great Nelmes, Hornchurch, Essex, Chemist.
1914. Barber, Charles F. L., 33, Hessle View, Brudenell Road, Leeds, Leather Chemist.
1908. Barber, Percy S., The Reform Food Stores, 84, Whitechapel, Liverpool, Chemist.
1901. Barber, Capt. René R., Georgetown, Ont., Canada, Analytical Chemist.
1911. Barclay, Andrew, Oficina Anita, Antofagasta, Chile, Chemist.
1912. Barclay, William R., 31, Glenalmond Road, Ecclesshall, Sheffield, Manager of Electroplate Factory and Lecturer in Electro-Metallurgy.
1892. Barden, Alf., Far Bank, Shelley, near Huddersfield, Glue and Size Maker.
1907. Bardorf, C. F., c/o St. Lawrence Sugar Refining Co., Maisonneuve, P.Q., Canada, Chief Chemist.
1902. Barker, Hugh S., 32, Cumberland Avenue, Sefton Park, Liverpool, Laboratory Furnisher.
1912. Barker, Dr. Jonathan T., Victoria Villa, Halkyn Street, Flint, North Wales, Chemist.
1895. Barlow, Clinton W., 104—112, East 25th Street, New York City, U.S.A., Merchant.
1901. Barlow, John J., Broadway, Accrington, Calico Printer's Chemist.
1899. Barlow, Wm., 23, Alton Terrace, Fairfield, Manchester, Analytical Chemist.
1908. Barnes, Alfred, Box 556, Pretoria, Transvaal, Dealer in Minerals.
1906. Barnes, A. G., c/o Hasland Coking Co., Grassmoor Collieries, Chesterfield, Colliery Proprietor.
1914. Barnes, Edward A., c/o The Giant Powder Co., Giant, Cal., U.S.A., Chemical Engineer.
1905. Barnes, F. V., Gas Works, Todmorden, Engineer and Manager.
1884. Barnes, H. J., Phœnix Chemical Works, Hackney Wick, N.E., Manufacturing Chemist.
1884. Barnes, Jonathan, 301, Great Clowes Street, Manchester, Analytical Chemist.
O.M. Barnes, Jos., Green Vale, Westhonghton, near Bolton, Lancashire, Analytical Chemist.
1912. Barnett, E. de Barry, 9, Collingham Road, South Kensington, S.W., Chemist.
1897. Barnett, Robt. E., 9, Virginia Road, Leeds, Headmaster (Leeds Technical School).
1904. Baron, Wm. Briscoe, c/o Vulcan Boiler and General Insurance Co., Ltd., 26, Pall Mall, Manchester, Chemist.
O.M. Barr, J., Dinting Vale, Dinting, near Manchester, Chemical Manager.
1914. Barraclough, Dennis H., North Brierley Sewage Works, Oakenshaw, Bradford, Chemist.
1890. Barraclough, Wm. H., Chapeltown House, Chapeltown, near Sheffield, Analytical Chemist.
1890. Barrett, Arthur A., 139, Viale San Martino, Messina, Sicily, Manufacturer of Essential Oils.
1907. Barrett, Maurice, 9, Roundhay Mount, Leeds.
1912. Barrow, Jas. V., c/o Messrs. W. H. Holmes and Sons, Portland Road, Newcastle-on-Tyne, Works Chemist.
1900. Barrow, Jos., "Woodhey," Malford Grove, South Woodford, N.E., Chemist.
1906. Barrs, Chas. E., 3A, Downshire Hill, Hampstead, N.W., Analyst.

1905. Barry, Eugene, Ayer, Mass., U.S.A., Leather Manufacturer.
1893. Barton, G. E., 227, Pine Street, Millville, N.J., U.S.A., Technical Chemist.
1903. Bartrip, Geo. F., 92, First Avenue, Bush Hill Park, N., Managing Chemist.
1905. Baruch, Edgar, 805-806, Wright and Callender Building, Los Angeles, Cal., U.S.A., Chemical Engineer.
1910. Barwick, F. W., Chamber of Commerce Testing House, Royal Exchange, Manchester.
1909. Barzano, Carlo, 6, Via Gesu, Milan, Italy, Patent Agent.
1895. Baskerville, Dr. Chas., College of the City of New York, New York City, U.S.A., Professor of Chemistry.
1884. Bassett, H., 26, Belitha Villas, Barnsbury, N.
1908. Bassett, Professor Henry, University College, Reading, Prof. of Chemistry.
1899. Bassett, Wm. H., Main Street, Cheshire, Conn., U.S.A., Chemist.
1899. Bate, William, Upton Villa, Hayle, Cornwall, Technical Chemist (National Explosives Co., Ltd.).
1903. Bateman, A. H., Eridge, Shooter's Hill, Woolwich, S.E., Chemist.
1913. Bateman, James T., 34, Bridge Avenue, Hammersmith, W., Engineer and Works Manager.
1912. Bates, D. M., Lewiston Bleachery and Dye Works, Lewiston, Maine, U.S.A., General Manager.
1914. Bates, John S., 227, Beruhé Street, Montreal, Canada, Superintendent.
1914. Battershy, W. H., Bury Corporation Gas Works, Elton, Bury, Lancs., Chief Chemist.
1885. Batty, R. B., Wharncliffe, Erdington, near Birmingham, Nickel Works Manager.
1910. Battye, Horace G., 28, Roman Place, Street Lane, Roundhay, Leeds, Chemist and Works Manager.
1903. Baty, E. J., c/o Thermoelectric Ore Reduction Corporation, Cobden Street, High Town, Luton, Beds, Chemist.
1903. Bauer, Geo. W., 660, Sacramento Street, San Francisco, Cal., U.S.A., Vice-President and Chemist (Hop and Malt Co.).
1915. Baumann, Dr. L., Manufacture Emile Zündel, Moscow; and (Journals) Commission Française, India House, Kingsway, London, W.C., Managing Director of Printworks.
1910. Baxter, F. Stanley, 119, Albert Street, Regent's Park, London, N.W., Chemist.
1913. Baxter, Harold R., c/o Aktiebolaget J. and G. Cox, Östrahamngatan 17, Gothenburg, Sweden, Manager (Glue Works).
1898. Baxter, John G., Glenarm, Lennox Avenue, Gravesend, Kent, Chemist.
1912. Bayley, Francis P., c/o F. S. Bayley, Clanahan, and Co., 79, Mosley Street, Manchester, Chemical Merchant.
1915. Bayley, Frank, 14, Slade Grove, Slade Lane, Longsight, Manchester, Technical Chemist.
1908. Bayly, Percival G. W., Mines Dept. Laby., Spring Street, Melbourne Victoria, Government Metallurgical Chemist.
1897. Beadle, Alec A., Donington Dene, Newbury, Berks, Electro-Chemist.
1886. Beadle, Clayton, Oakbank, Lansdown Road, Sidcup, Kent, Consulting Chemist.
1911. Beard, Stanley D., Lederle Antitoxin Laboratories, Pearl River, N.Y., U.S.A., Biological Chemist.
1907. Beardsley Dr. Alling P., 165, Minerva Street, Derby, Conn., U.S.A., Chemist (New Haven Gas Co.).
1903. Bearpark, Arthur F., P.O. Box 497, Durban, South Africa, Works Manager.
1908. Beasley, Fred. G., 44, Green Street, Smethwick, near Birmingham, Metallurgical Chemist.
1905. Beasley, Jno. K., c/o The Borneo Co., Kuching, Sarawak, Metallurgical Chemist.
1905. Beckers, Dr. Wm., 105, Underhill Avenue, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
1909. Becket, Fredk. M., 31, Sugar Street, Niagara Falls, N.Y., U.S.A., Chief Metallurgist, Electro Metallurgical Co.
1912. Beckett, Dr. E. G., No. 1, Sandhills, Ardeer, Stevenston, Ayrshire, Analytical Chemist.
1899. Bedford, Alf. C., 26, Broadway, New York City, U.S.A., Chemical Merchant.
1891. Bedford, Chas. S., Rocella, Westwood, Headingley, Leeds, Manufacturing Chemist.
1911. Bedforth, G. E., Aspley Dyeware Mills, Huddersfield, Works Chemist.
O.M. Bedson, Prof. P. Phillips, Armstrong College, Newcastle-on-Tyne, Professor of Chemistry.
1901. Beevers, Clifford J., 12, Parish Ghyll Road, Ilkley, Yorks, Analyst.
1903. Behrend, F., 54, Front Street, New York City, U.S.A., Importer of Chemical Stoneware.
O.M. Beilby, Dr. George T., F.R.S., 11, University Gardens, Glasgow, Chemical Engineer.
1912. Belajew, Captain Nicolai, Chem. Lahy., Michael Artillery Academy, Petrograd, Russia, Lecturer in Metallurgy and Chemistry.
1906. Belden, A. W., c/o Jones and Laughlin Steel Co., Aliquippa Works, Woodlawn, Pa., U.S.A., Coke Expert.
1884. Bell, Sir Hugh, Bart., Middlesbrough-on-Tees, Soda and Iron Manufacturer.
1900. Bell, Hugh P., c/o Bank of Montreal, Toronto, Canada, Chemist.
1886. Bell, J. Ferguson, Derby Gas Light and Coke Co., Derby, Gas Engineer.
1907. Bell, Marcus, Defence Dept., Melbourne, Victoria, Chemist.
1905. Bell, Miss M. M., Tulane University Library, New Orleans, La., U.S.A., Librarian.
1903. Bell, P. Carter, Millburn, N.J., U.S.A., Chemical Manufacturer.
O.M. Bendix, D., 371, Romford Road, Forest Gate, E., Managing Chemist, British Alizarin Co., Ltd.
1897. Bonfey, Dr. Hans, 36, Marché aux Oeufs, Antwerp, Belgium, Manufacturing Chemist.
1903. Benham, Keith, The Woodlands, Rowley Park, Stafford, Analytical and Consulting Chemist.
O.M. Benjamin, Dr. M., Smithsonian Institution, Washington, D.C., U.S.A., Consulting Chemist.
1899. Bennett, Alex. H., Via Giuseppe La Farina, Messina, Sicily, Chemist.
1907. Bennett, H. Garner, 115, Grovehill Road, Beverley, Yorks, Leather Chemist.
1909. Benson, George F., Edwardsburg Starch Co., Cardinal, Ontario, Canada, President and Managing Director.
1901. Bentley, Wm. H., 12, Cromwell Terrace, Irlam, near Manchester, Technical Chemist.
1890. Bentz, Ernest, 30, Manley Road, Whalley Range Manchester, Technical Chemist.
1913. Benzian, Dr. Rudolf, Hohe Bleichen 34, Hamburg, Germany, Assayer and Merchant.
1912. Bergius, Dr. Friedrich, Parkstrasse 1, Hannover, Germany, Privatdozent.
1912. Beringer, C. R., Magyar Onmüvek, Nagytétény, Hungary, Assayer.
1884. Beringer, J. J., Basset Road, Camborne, Cornwall, Metallurgist.
1893. Berk, Fred. W., 1, Fenchurch Avenue, London, E.C., Chemical Manufacturer.
1907. Berk, Paul F., 1, Fenchurch Avenue, London, E.C., Chemical Manufacturer.
1889. Bernard, Jas., jun., c/o Parry and Co., P.O. Box No. 12, Madras Presidency, India, Chemical Works Manager.
1897. Berry, Albert E., Abbotsleigh, Wanstead, Essex, Works Manager.
1911. Berry, Arthur G. V., c/o Sir Boverton Redwood, Bart., 4, Bishopsgate, London, E.C., Analyst.
1906. Berry, Arthur J., 14, Regent Street, Cambridge, Chemist.
1883. Berry, E. E., Bordighera, Italy, and (Journals) c/o C. H. Grinling, 17, Rectory Place, Woolwich, S.E., Technical Chemist.

1913. Berry, Prof. R. A., The Agricultural College, Blythswood Square, Glasgow, Prof. of Agric. Chemistry.
1903. Berry, W. G., 329, West 83rd Street, New York City, U.S.A., Chemist.
1909. Beskow, K. J., Södra Storgatan 19, Helsingborg, Sweden, Head Engineer.
1914. Best, Ronald L., 55, Derwent Road, Palmer's Green, N., Analytical Chemist.
1886. Best, Dr. T. T., Hardshaw Brook Chemical Works, St. Helens, Lancashire, Technical Chemist.
1914. Bettesworth, A. E. A., 490, St. Paul Street, Montreal, Canada, Managing Director.
1901. Betts, Anson G., Box 792, Ashville, N.C., U.S.A., Chemist.
O.M. Bevan, E. J., 4, New Court, Lincoln's Inn, London, W.C., Public Analyst and Consulting Chemist.
1900. Bevan, Jno. W., Morriston Spelter Works, Morriston, R.S.O., Glamorgan, Manager of Metallurgical Works.
O.M. Beveridge, Jas., Springfield House, Chatham, N.B., Canada, Pulp and Paper Manufacturer.
1909. Bewick, R. M., "Lynton," Park West, Heswall, Cheshire, Traveller.
1898. Bhattacharyya, Haripada, Gun and Shell Factory, Ishapore, Bengal, India, Chemist.
1896. Bibby, John, c/o J. Bibby and Sons, Formby Street, Liverpool, Chemist.
O.M. Bickerdike, W. E., Bryer's Croft, Wilpshire, near Blackburn, Manufacturing Chemist.
1907. Bickerstaffe, Robert, c/o J. Knowles, 128, Blackburn Road, Clayton le Moors, near Accrington, Chemist.
1903. Bierwith, L. W., c/o Du Pont Powder Co., Haskell, N.J., U.S.A., Civil Engineer.
1910. Bigelow, Chas. A., c/o Pluto Powder Co., Ishpeming, Mich., U.S.A., Superintendent.
1912. Bigelow, Edward P., Mellin's Food Library, 291, Atlantic Avenue, Boston, Mass., U.S.A., Chemist.
1884. Biggart, J. Wm., 29, Cathcart Street, Greenock, Scotland, Analytical Chemist.
1891. Biggart, Wm. L., Rossarden, Kilmacolm, Scotland, Public Analyst.
1911. Biggins, J. E., c/o Gulf Refining Co., Port Arthur, Texas, U.S.A.. Chemist.
1910. Biggs, J. W. H., 318, High Street, Plumstead, S.E., Chemist.
O.M. Billing, H. S., 42, Kingsley Road, Mutley, Plymouth, Analytical and Managing Chemist.
1896. Billington, Chas., Heimath, Porthill, Longport, Staffordshire, Metallurgist.
1907. Bird, Charles S., jun., Messrs. F. W. Bird and Son, Library Dept., East Walpole, Mass., U.S.A., Paper Maker.
1895. Bird, Wm. R., (communications) 125, Goddard Avenue; (Journals) Laboratory, G.W.R. Works, Swindon, Wilts., Analytical Chemist.
1902. Bird, W. Robt., 217, Newport Road, Cardiff, Oil Merchant.
1915. Birley, J. Harold, c/o Chas. Macintosh and Co., Ltd., Cambridge Street, Manchester, Indiarubber Manufacturer.
1883. Bishop, A. Conway, Three Mills Lane, Bromley-by-Bow, E., Manufacturing Chemist.
1884. Bishop, Fred., c/o Burmah Oil Co., P.O. Box 67, Rangoon, Burmah, Technical Chemist.
1903. Bishop, Howard B., 1372, Union Street, Brooklyn, N.Y., U.S.A., Chemist.
1903. Bishop, J. T. F., Chemical Club, Victoria Hotel, Manchester, Secretary.
1905. Bixby, Willard G., 46th Street and 2nd Avenue, Brooklyn, N.Y., U.S.A., Blacking Manufacturer.
1905. Bjerregaard, A. P., 10724, Kimberley Avenue, Cleveland, Ohio, U.S.A., Varnish Chemist.
1912. Björnström-Steffanson, G., Bathurst, New Brunswick, Canada, Pulp and Paper Works Manager.
1909. Blacher, Prof. Carl, Polytechnicum, Riga, Russia, Chemical Engineer.
1904. Black, J. Wyolif, 67, Falcon Road, Edinburgh, Analytical Chemist.
1902. Black, W. Geoffrey, St. John's House, Christchurch Road, Norwich, Chemist.
1910. Blackie, Archibald, 223, James Street, Winnipeg, Canada, Chemist.
1894. Blackmore, H. S., P.O. Box 145, Mount Vernon, N.Y.. U.S.A., Industrial Chemist.
1896. Blagden, Victor, 4, Lloyd's Avenue, London, E.C., Chemical Merchant.
1883. Blagden, W. G., Down Lodge, East Harting, near Petersfield, Hants, Chemical Merchant.
1897. Blair, Andrew A., 406, Locust Street, Philadelphia, Pa., U.S.A., Analytical Chemist.
1915. Blake, Azel F., Atlantic Sugar Refineries, Ltd., St. John, New Brunswick, Canada, Chief Chemist.
1884. Blake, Jas., Thames Sugar Refinery, Silvertown, E., Manager.
1910. Blakeley, A. G., P. and R. Coal and Iron Co., Pottsville, Pa., U.S.A., Chemist.
1913. Blane, E. R., c/o I. Levinstein and Co., Inc., 115, 5th Street, Chelsea, Mass., U.S.A., Chemist.
1893. Blears, John, c/o Langworthy Bros. and Co., Ltd., Greengate Mills, Salford Dyer and Calico Printer.
1908. Blichfeldt, S. H., Vine Cottage, Southall, Middlesex, Bacteriologist and Fermentation Chemist.
1905. Bliss, H. J. W., United University Club, Pall Mall East, London, S.W., Chemist.
1889. Bloede, Victor G., Station D., Baltimore, Md., U.S.A., Manufacturing Chemist.
1908. Blomeley, Adam Y., c/o Arbuckle Bros. Sugar Refinery, Brooklyn, N.Y., U.S.A., Chemist.
1891. Bloomer, Fred J., Penpont, Clydach, R.S.O., Glamorgan, Nickel Works Manager.
1886. Blount, Bertram, Laboratory, 76 and 78, York Street, Westminster, S.W., Analytical Chemist.
1888. Bloxam, A. G., 29, Southampton Buildings, Chancery Lane, London, W.C., Chemist and Patent Agent.
1903. Blumenthal, Lionel, Ravensholme, Merry Bower Road, Broughton Park, Manchester, Chemist.
1886. Blundstone, E. R., 79, York Street, Westminster, S.W., Consulting Chemist.
1906. Blyth, M. Wynter, Lacton House, Tankersley, near Barnsley, Yorks, Analytical and Consulting Chemist.
1908. Blythe, Jas. R., Craiglea, Audenshaw, near Manchester, Leather Trades Chemist.
O.M. Boake, A., Warton Road, Stratford, E., Manufacturing Chemist.
1888. Boake, Edmund J., Widford Lodge, Chelmsford, Essex, Manufacturing Chemist.
1912. Bosn, Robt., Laboratory, Government Railway Offices, Spencer Street, Melbourne, Vic., Australia, Engineer-in-charge.
1915. Boardman, Fred., "Knole," Burscough, near Ormskirk, Lancs, Metallurgical Chemist.
1899. Boehm, Fred., 16, Jewry Street, London, E.C., Chemical Agent and Merchant.
1910. Boehringer, Dr. R., 79, Milford Avenue, Newark, N.J., U.S.A., Chemist.
1898. Bogert, Prof. Marston T., Department of Organic Chemistry, Columbia University, New York City, U.S.A., Professor of Organic Chemistry.
1903. Boissevain, Chas. E. H., 92, Van Eeghenstraat, Amsterdam, Holland, Chemical Manufacturer.
1903. Bolam, Dr. H. W., Queen Margaret College, Glasgow, Lecturer on Chemistry.
1909. Bolden, Wm., Dalmellington Iron Works, Dunaskin, Ayrshire, Chemist.
1901. Bolton, E. Richards, 46, Stamford Brook Road, Hammersmith, W., Manufacturing Chemist.
1905. Bond, John, Crowlands, Southport, Engineer.
1905. Bond, Josiah, Alto, Arizona, U.S.A., Mining Engineer.
1912. Bone, S. C., 30, Long Lane, Garston, Liverpool, Chemical Works Manager.
1905. Bone, Prof. W. A., F.R.S., "Montrose," Harpenden Road, St. Albans, Herts, Professor of Chemical Technology.
1892. Bookman, Dr. S., 46, East 82nd Street, New York City, U.S.A., Chemist.
1914. Boon, A. Archibald, Chemistry Dept., Heriot Watt College, and (Juls.) 87, Warrender Park Road, Edinburgh, Assistant Professor of Chemistry.

1898. Boor, Leonard G., 21, Mincing Lane, London, E.C., Chemical Merchant.
1912. Boorne, Wm. H., Bush Lane House, Cannon Street, London, E.C., Metallurgist.
1908. Booth, Jos. W., George E. Kunhardt Mills, Lawrence, Mass., U.S.A., Superintendent.
1904. Booth, N. Parr, Laboratory, Cadbury Bros., Ltd., Bournville, near Birmingham, Chemist.
1903. Boral, Robin, Rhodes Mount, Rhodes, near Manchester, Works Manager.
1897. Borland, C. R., Concord, Mass., U.S.A., Smokeless Powder Manufacturer.
O.M. Borland, W. D., Beacon Lodge, Bean, *viâ* Dartford, Kent, Manufacturer of Explosives.
1908. Bose, R., 92-95, Upper Circular Road, Calcutta, India, Chemical Works Manager.
1890. Bost, W. D. Ashton, Cartvale Chemical Works, Paisley, Chemical Manufacturer.
1912. Boswell, Maitland C., Chemistry and Mining Building, University of Toronto, Canada, Lecturer on Organic Chemistry.
O.M. Bothamley, C. H., Weston-super-Mare, Somerset, County Director of Technical Instruction.
1890. Bott, Dr. W. Norman. *See* Norman-Bott, Dr. W.
1884. Böttinger, Dr. H. T. von, Elberfeld, Germany; and (snbs.) c/o The Bayer Co., Ltd., 19, St. Dunstan's Hill, London, E.C., Colour Manufacturer.
1901. Bottomley, Dr. J. Frank, c/o The Thermal Syndicate, Ltd., Neptune Road, Wallsend-on-Tyne, Consulting Chemist.
1906. Bottomley, W., c/o The United Alkali Co., Ltd., Chief Engineer's Office, Widnes, Engineer.
O.M. Boulton, H. E., 64, Cannon Street, London, E.C., Chemical Manufacturer.
O.M. Boulton, Sir Samuel B., Bart., 64, Cannon Street, London, E.C., Chemical Manufacturer.
1883. Boulton, T. S., 14, Freegrove Road, Caledonian Road, London, N., Manager.
1905. Bourne, Lyman M., c/o Goodyear Tire and Rubber Co., Akron, Ohio, U.S.A., Chemist.
1010. Bowater, J. W., Woodville, Beeches Road, West Bromwich, Works Manager.
1905. Bowen, Henry, South Street, East Aurora, N.Y., U.S.A., Secretary.
1888. Bower, Frank, Brewery House, Spitalfields, E., Analytical Chemist.
1909. Bower, Joshua, c/o Kynoch, Ltd., Arklow, Co. Wicklow, Ireland, Chemist.
1897. Bower, Wm. H., 29th Street and Gray's Ferry Road, Philadelphia, Pa., U.S.A., Chemical Manufacturer.
1892. Bowes, Harry, 9, Park Road, Heaton Moor, Stockport, Analytical Chemist.
1883. Bowley, Jos. John, Wellington Works, Battersea Bridge, London, S.W., Chemical Manufacturer.
1899. Bowley, J. Plunkett, 36, Argyll Mansions, Chelsea, London, S.W., Varnish Manufacturer.
1908. Bowman, Fred. C., 179, Marcy Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1884. Bowman, R., c/o Bowman's Ltd., Lythgoe's Lane, Warrington, Chemical Manufacturer.
1907. Bowman, Richard S., "Castlewood," Elm Grove, West Hartlepool, Chemist.
1896. Bowman, Walker, 39, Cortlandt Street, New York City, U.S.A., Chemist.
1904. Boyce, Framroze H., 86, Hugh's Road, Chanpaty, Bombay, India, Technical Chemist.
1893. Boyce, Frank, c/o Goodall Backhouse and Co., White Horse Street, Leeds, Technical Chemist.
1910. Boyce, James, 6647, Harvard Avenue, Chicago, Ill., U.S.A., Chemist.
1909. Boyd, Dr. Harold de H., c/o The Southern Cotton Oil Co., Ltd., Trafford Park, Manchester, Chemist.
1913. Boyd, Robert, c/o British Columbia Sugar Refining Co., Ltd., Vancouver, B.C., Canada, Chemist.
1909. Boyd, T. D., jr., P.O. Box 381, Nogales, Arizona, U.S.A., Sugar Refiner.
1885. Bradburn, J. A., 311, Montgomery Street, Syracuse, N.Y. U.S.A., Manufacturing Chemist.
1912. Bradford, Francis L. W., 92, Rotton Park Road, Edgbaston, Birmingham, Chemist and Works Manager.
1895. Bradford, Henry, Strettington, Goodwood, near Chichester, Analytical Chemist.
1896. Bragg, Everett B., 1838, Chicago Avenue, Evanston, Ill., U.S.A., Manufacturing Chemist.
1891. Braithwaite, Isaac, Ghyll Close, Kendal, Westmoreland, Drysalter.
1897. Braithwaite, Jno. O., Holme Lacey, Warren Road, Chingford, Essex, Pharmaceutical Research Chemist.
1903. Brame, J. S. S., 67, Coleraine Road, Blackheath, S.E., Demonstrator in Chemistry.
O.M. Bramham, W., Bank Chambers, 300, Mare Street, Hackney, N.E., Chemical Engineer.
1904. Brandeis, R., Oesterreichischer Verein f. Chem. und Metall. Produktion, Aussig, Austria, Chemical Manufacturer.
1902. Branegan, Jas. Aug., 12, Park Avenue, Millbourne, Delaware Co., Pa., U.S.A., Chemical Salesman.
O.M. Branson, F. W., Wynneholme, Far Headingley, Leeds, Pharmaceutical Chemist.
1903. Brassard, Fred à, 46, Vicar Lane, Bradford, Yorks, Aniline Dyestuff Importer.
1901. Brearley, Harry, c/o The Amalgams Co., Ltd., Attercliffe Road, Sheffield, Analytical Chemist.
1906. Breckenridge, John E., American Agricultural Chemical Co., Carteret, N.J. U.S.A., Chemist.
1900. Brewis, E. T., 31, Belgrave Road, Leyton, E., Chemist.
1894. Breyer, Theodor, 725, Washington Avenue, Wilmette, Ill., U.S.A., Chemist.
1885. Briant, L., 24, Holborn Viaduct, London, E.C., Analytical Chemist.
1913. Bridge, Stanley W., c/o Dr. H. G. Colman, 1, Arundel Street, London, W.C., Analytical Chemist.
1890. Brierley, J. T., Highfield, Golden Hill, Leyland, near Preston, Lancs., Analytical Chemist.
1893. Briggs, J. F., Auchmuty Paper Mills, Markinch, Fifeshire, Technical Chemist.
1912. Briggs, O. W. H., Chemist.
1885. Briggs, T. Lynton, 188, Central Avenue, Flushing, Long Island, N.Y., U.S.A., Technical Chemist.
1914. Brinsley, Frank, Victoria College, Stellenbosch, South Africa, Demonstrator in Physical Chemistry.
1910. Brisbane, James W., c/o The Leather Cloth Co., Ltd., West Ham, E., Analytical Chemist.
1905. Bristol, Dr. H. Stanley, 804, Colorado Building, Washington, D.C., U.S.A., Chemist.
1886. Bristow, G. W., c/o Walter J. Crook, 10, Eastcheap, London, E.C., Chemical Manager.
1912. Britland, Wm. J., Pear Tree Cottage, Alvanley, near Helsby, Cheshire, Chemist.
1887. Broadbent, H., c/o Goodall, Backhouse and Co., Sovereign Street, Leeds, Chemist.
1889. Brock, Arthur, Firework Factory, Sutton, Surrey, Firework Manufacturer.
O.M. Brock, J., The Cedars, Hoole, Chester, Chairman of United Alkali Co., Ltd.
1910. Brodribb, Noel K. S., Cordite Factory, Ascot Vale, Melbourne, Victoria, Australia, Chemist.
1912. Bromley, Henry S., 1000, Wissahickon Avenue, Germantown, Philadelphia, Pa., U.S.A., Lace Manufacturer.
1909. Bronnert, Dr. E., Dornach, near Mülhausen, Alsace, Germany, Artificial Silk Manufacturer.
1896. Brooke, C. B., jun., Colne House, Brantham, near Manningtree, Xylonite Manufacturer.
1900. Brooke, Jno. R., Government Opium Factory, Singapore, S.S., Superintendent.
1884. Brookes, E. A., c/o The Chilian Mills Co., Ltd., Chiguayante, Concepcion, Chile, Chemist.
1906. Brooks, Cecil J., c/o M. M. Simau, Benkoelen, Sumatra, Ned. India, Metallurgist.
1909. Brooks, Theodore, Guantanamo, Cuba, Cane Sugar Manufacturer

1911. Brothers, Horace E., Higher Knutsford Road, Latchford, Warrington, H.M. Inspector of Factories.
1909. Brothers, Wm., Meadow House, Tunstead Milton, near Whaley Bridge, Derbyshire, Chemical Manufacturer.
O.M. Brotherton, E. A., City Chambers, Leeds; Ammonia Distiller.
1884. Brown, Prof. A. Crum, F.R.S., 8, Belgrave Crescent, Edinburgh, Professor of Chemistry.
1905. Brown, Prof. Adrian J., West Heath House, Northfield, near Birmingham, Professor of Brewing.
1902. Brown, A. H. M., Hudson Bay Mine, Cobalt, Ont., Canada, Metallurgist.
1891. Brown, Cæsar R., 141, Victoria Avenue, Prittlowell, near Southend, Works Foreman.
O.M. Brown, D., 93, Abbey Hill, Edinburgh, Chemical Manufacturer.
O.M. Brown, D., Donaghmore, Tyrone, Ireland. Soap Manufacturer.
1890. Brown, Edw. Hilton, c/o W. Ropes and Co., Petrograd, Russia, Analytical Chemist.
1894. Brown, Geo. E., c/o "The British Journal of Photography," 24, Wellington Street, Strand, London, W.C., Chemist.
1910. Brown, Geo. Winslow, Assabet Mills, Maynard, Mass., U.S.A., Chemist.
O.M. Brown, Henry, Benskin's Brewery, Watford, Herts., Brewing Chemist.
1899. Brown, Dr. Henry G., The Chemical Works, King's Lynn, Chemical Manufacturer.
O.M. Brown, Dr. Horace T., F.R.S., 52, Nevern Square, Kensington, S.W., Brewing Chemist.
1905. Brown, Hugh B., c/o Jas. Robertson and Sons, Ltd. Thrushgrove Works, Paisley, Chemist.
1892. Brown, Reginald B., c/o Badische Co., Ltd., 20—26, Brunswick Place, City Road, London, N., Technical Chemist.
1901. Brown, Samuel B., Ruthven, Bowden Lane, Marple, Cheshire, Calico Printer.
O.M. Brown, Walter, c/o Jas. H. Dennis and Co., Ltd., Widnes, Technical Chemist.
1900. Brown, Walter B., Victor Chemical Works, 1805, Fisher Building, Chicago, Ill., U.S.A., Chemist and General Superintendent.
1901. Browne, Dr. Arthur L., 215, East Fayette Street, Baltimore. Md., U.S.A., Analytical Chemist.
1900. Browne-Cave, E. J. C. *See* Cave-Browne-Cave, E. J.
1905. Browning, Prof. K. C., Medical College, Colombo, Ceylon, Professor of Chemistry.
O.M. Browning, W., Broad Oak, Accrington, Calico Printer.
1902. Brownsdon, Dr. H. W., King's Norton Metol Co., Ltd., King's Norton, Birmingham, and (Jnls.) 109, Oxford Road, Moseley, near Birmingham, Works Chemist.
1902. Bruce, Alex., Laboratory, Hyde Park Corner, Colombo, Ceylon, Chemist.
1911. Bruce, Joseph, Jnls. to General Manager, Dynamite Factory, West Somerset, Cape Colony, Secretary.
1908. Bruce, Robert, c/o Clark, 191, Morningside Road, Edinburgh, Works Chemist.
1900. Bruce, Wm. T., 3, Lombard Court, London, E.C., and (Jnl.) c/o T. C. Allchin, Longfield, Kent, Director.
1892. Bruckmann, G. T., 109, 22nd Street, Guttenberg P.O., N.J., U.S.A., Chemical Engineer.
1911. Brunet, Louis, "Revue Générale des Sciences," 97, Boul. Montmorency, Paris XVI, France, Chemist and Secretary.
O.M. Brunner, H., Holly Mount, Tarbock Road, Huyton, near Liverpool, Chemical Manufacturer.
1894. Brunner, H. Bertram, The Hollies, Hartford, Cheshire, Chemist and Electrician.
1887. Brunner, J. F. L., M.P., c/o Brunner, Mond, and Co., Ltd., Caxton House. Westminster, S.W., Chemical Manufacturer.
O.M. Brunner, Rt. Hon. Sir J. T., Bart., Silverlands, Chertsey; and (Journals) c/o Brunner, Mond, and Co., Ltd., Northwich, Cheshire, Chemical Manufacturer.
1910. Brunner, Dr. Philipp, 2, Via Ghega, Trieste, Austria, Merchant.
1902. Brunner, Roscoe, The Winnington Hall Club, Winnington, Northwich, Alkali Manufacturer.
1894. Brunton, J. Dixon, Wire Mill, Musselburgh, Scotland, Wire Manufacturer.
1904. Bryant, Arthur P., c/o Clinton Sugar Refining Co., Clinton, Iowa, U.S.A.. Chemist.
1903. Bryce, Chas. C., 43-45, Great Tower Street, London, E.C., Merchant.
1894. Bryce, Thos., Tharsis Mines, Huelva, Spain, Chemist.
1897. Bryson, Jas., Pumpherston Oil Works, Midcalder, Scotland, Oil Works Manager.
1892. Buchanan, D. G., Riverstone, John Street, Helensburgh, Glasgow, Analyst.
1908. Buchanan, Duncan G., 27, Woodlawn Avenue East, Toronto, Canada, Chemist (Ruhber Works).
1904. Buchanan, E. F., 128, East Crescent Street, Marquette, Mich., U.S.A., Chemist.
1888. Buchanan, Jas., Caledonia Foundry, Brasenose Road, Liverpool, Engineer.
1904. Buchanan, John L., Brachead, Mill Road, Bromborough, Cheshire, Analytical Chemist.
1904. Buchanan, Joshua D., c/o Nobel's Explosives Co. Ltd., Polmont Station, Scotland, Chemist.
1910. Buchanan, Walter G., c/o Lautaro Nitrate Co., Taltal, Chile, Chemist.
1897. Buck, Chas. A., 521, Locust Street, South Bethlehem, Pa., U.S.A., Chief Chemist (Bethlehem Iron Co.).
1911. Budde, Dr. Carl, 1, Belford Road, Sunderland, Chemical Engineer.
1909. Buell, W. H., c/o Winchester Repeating Arms Co., New Haven, Conn., U.S.A., Chemist.
1909. Buggy, Thos., Butte, Montana, U.S.A., Assayer and Chemist.
1902. Bull, Irving C., 100, Maiden Lane, New York City, U.S.A., Chemist.
1899. Bult, Herbert J., 140, Fenchurch Street, London, E.C., Chemist.
O.M. Bumby, H., Bellevue, Sandbach, Cheshire, Iron and Chemical Works Director.
O.M. Bunker, H. E., 310, Kingston Road, Toronto, Ont., Canada, Technical Chemist.
1901. Bunting, Henry H., Oficina de Ensayes F. C. C. del P., Callao, Peru. Analyst.
1893. Burbridge, Jas., India-rubber Mills, Tottenham, N., India-rubber Manufacturer.
1910. Burbridge, Walter N., Denman House, Denman Street, London Bridge, S.E., Analytical Chemist.
1896. Burford, Samuel F., The Ridgeway, Rothley, near Leicester, Analytical Chemist.
1889. Bürger, Dr. J., 9, Vincent Avenue, Chorlton-cum-Hardy, Manchester, Technical Chemist.
1889. Burgess, Geo., Sydney Cottage, Halebank, Widnes, Chemist.
1913. Burgess, Herbert E., Holly House, Graham Road, Dalston, N.E., Manufacturing Chemist.
1889. Burgess, Wm. T., 20, Priory Road, Bedford Park, London, W., Analytical Chemist.
1902. Burkard, Dr. Ernst, Solothurn, Switzerland, Chemist.
1899. Burkhardt, Dr. G. A., Württembergischestrasse 32, Berlin, W. 15, Germany, Chemist.
1898. Burls, Herbert T., 2, Verulam Buildings, Gray's Inn, London, W.C., Mechanical Engineer.
1891. Burnet, Henry K., North Brook Vitriol Works, Bradford, Yorks, Sulphuric Acid Maker.
1897. Burnet, Jno. Jas., 18, University Avenue, Glasgow, and (Journals) 1, Montague Place, Bedford Square, London, W.C., Architect.
1909. Burnett, Arthur, Clairville, Weaste Lane, Pendleton, Manchester.
1893. Burnham, J. C., Cordite Factory, Aruvankad, Nilgiri Hills, India, Analytical Chemist.
1900. Burr, Edmund C., 1722, Vallejo Street, San Francisco, Cal., U.S.A., Manufacturer.

O.M. Burrell, B. A., 8, Springfield Mount, Leeds, Analytical Chemist.
1910. Burrell, Keith, Burrell's Wharf, Millwall, London, E., Manufacturer.
1906. Burrough, Ernest J., Cale Distillery, Hutton Road, Lambeth, S.E., Rectifier.
1912. Burt-Gerrans, J. T., 46, Dewson Street, Toronto, Canada, Electro-Chemist.
1901. Burton, Alf., Canadian Dyers' Association, 2-16, Liberty Street, Toronto, Canada, Dyer and Finisher.
1914. Burton, Donald, Westbourne, St. Andrew's Avenue, Morley, near Leeds, Research Assistant.
1903. Burton, Jno., 2, Green Street, Bethnal Green, E., Dye and Chemical Manufacturer.
1914. Burton, Tom F., 63, Melbury Gardens, West Wimbledon, S.W., Editor.
1904. Burton, T. R., c/o Scott, Greenwood, and Son, 8, Broadway, Ludgate Hill, London, E.C., Technical Journalist.
1889. Burton, Wm., The Hollies, Clifton Junction, near Manchester, Potter's Chemist.
1906. Busby, Fred. E., Arnold Print Works, North Adams, Mass., U.S.A., Chemist.
1913. Bush, Dr. Harry T., 7, Gracechurch Street, London, E.C., Chemical Engineer.
1897. Bush, J. M., c/o W. J. Bush and Co., Ltd., Ash Grove, Hackney, E., Manufacturing Chemist.
1897. Butler, David B., 41, Old Queen Street, Westminster, S.W., Cement Expert.
1913. Butler, Geo. B., West Lyn, Hawthorne Terrace, South Bank, R.S.O., Yorks, Assistant Blast Furnace Manager.
1890. Butler, Paul, Lowell, Mass., U.S.A., Ammunition Manufacturer.
1885. Butler, Samuel, The Cedars, Compton, Wolverhampton, Brewer.
1905. Butler, Dr. T. H., c/o Wm. Butler and Co., Ltd., Crews Hole, Bristol, Chemist (Tar and Rosin Distillery).
1886. Butler, W. W., c/o Mitchells & Butlers, Ltd., The Brewery Library, Cape Hill, Birmingham, Brewer.
O.M. Butterfield, J. C., 79, Endlesham Road, Balham, S.W., Analytical Chemist.
1892. Butterfield, W. J. A., 66, Victoria Street, Westminster, S.W., Analytical Chemist.
1897. Butters, Charles, 54, New Broad Street, London, E.C., and (Journals) 121, 59th Street, Oakland, Cal., U.S.A., Metallurgist.
1900. Butterworth, Elwell R., c/o Reversible Collar Co., 111, Putnam Avenue, Cambridge, Mass., U.S.A., Chemist.
O.M. Byard, A. G., c/o Burt, Boulton, and Haywood, Apartado 8, Bilbao, Spain, Technical Chemist.
1905. Byrne, F. A., 2, Ludgate Hill, Birmingham, Director of Chemical Co.
1893. Byrom, T. H., Virol Research Laboratories, 10, Bedford Square, London, W.C., Analytical Chemist.
1915. Bywaters, H. W., 9, Henleaze Avenue, Bristol, Chemist.

## C

1914. Cabana, Louis, 316, Herkimer Street, Buffalo, N.Y., U.S.A., Purchasing Agent and Chemist.
1884. Cabot, Godfrey L., 940, Old South Building Boston, Mass., U.S.A., Manufacturing Chemist.
1907. Cabot, Samuel, 141, Milk Street, Boston, Mass., U.S.A., Chemical Manufacturer.
1906. Caddick, Arthur, Minas de Rio Tinto, Huelva, Spain, Works Chemist.
1889. Cadett, Jas., Ashtead, Surrey, Chemical Engineer.
1905. Cain, Dr. J. C., 24, Aylestone Avenue, Brondesbury Park, N.W., Colour Chemist.
1891. Caines, G. S. A., 68, Hilldrop Crescent, Camden Road, London, N.W., Analytical Chemist.
1897. Cairns, Wm., 5, Carlton Place, Glasgow, Plumber.
1907. Caistor, J. W. Y., Ty Coch, Deganwy, North Wales, Chemist.
1905. Calder, Prof. Edwin E., Long Meadow, R.I., U.S.A., Professor of Chemistry.
1897. Calder, W. A. S., 449, Hagley Road, Birmingham, Chemical Manufacturer.
1908. Caldwell, Dr. Robert J., Rosendale, Holland Park, Belfast, Ireland, Chemist and Works Manager.
1912. Caldwell, Wallace L., 1025½, North 24th Street, Birmingham, Ala., U.S.A., Engineering Chemist.
1888. Caldwell, Wm., Murray Street, Paisley, Scotland, Drysalter.
1912. Callan, Dr. Thomas, Chemical Laboratory, 49, High Street, Paisley, Technical Chemist.
1902. Calm, Dr. Chas. E., California Club, Los Angeles, Cal., U.S.A., Manufacturing Chemist.
1913. Calvert, A. F., Royston, Eton Avenue, London, N.W., Engineer.
1904. Calvert, Dr. Harry T., West Riding of Yorkshire Rivers Board, Wakefield, Chemist.
1895. Cambier, Jacob, 1401, Carteret Avenue, Pueblo, Colo., U.S.A., Chemist.
1904. Cameron, Walter S., 239, West 136th Street, New York City, U.S.A., Manufacturing Perfumer.
1908. Cameron, Wm., Balik Pappan, Koctei, East Borneo, Sugar Refinery Manager.
O.M. Cannack, J., 34, Wolseley Road, St. Helens, Lancashire, Technical Chemist.
1886. Campbell, Andrew, 1, Park Road, Beckenham, Kent, Chemist (Mineral Oil).
1912. Campbell, Arthur F., 9, Fort Road, Sedgley Park, Manchester, Research Chemist.
1908. Campbell, Fred. A., The Working Men's College, Latrobe Street, Melbourne, Victoria, Australia, Principal.
1910. Campbell, James R., Chemist.
1907. Campbell, John A., c/o British South African Explosives Co., Modderfontein, Transvaal, Chemist.
1912. Campbell, Kennedy, c/o British Dyewood Co., Ltd., Parkhead, Glasgow, Chemist.
1901. Campbell, Kenneth F., M.Inst.C.E., 1, Peel Street, Huddersfield, Civil Engineer.
1911. Campbell, L. E., Dept. of Agriculture. Peradeniya, Ceylon, Chemist.
1908. Campbell, Max. E., 629, Langhlin Building, Los Angeles, Cal., U.S.A., Chemist.
1909. Campbell, Peter, Kearny, N.J., U.S.A., Linoleum Manufacturer.
1915. Campbell, W. B., Forest Product Laboratories, 700, University St., Montreal, Canada, Chemist.
1911. Campbell, Wm. E., c/o Gutta Percha and Rubber Ltd., O'Hara Avenue, Toronto, Canada, Industrial Chemist.
1914. Camus, Edward C. A., 8, Rue de Mondovi, Paris I., France, Chemical Merchant.
1909. Candee, Chas. N., 39, South Drive, Toronto, Canada, Rubber Manufacturer.
1908. Canning, Ernest R., 137, Great Hampton Street, Birmingham, Manufacturer.
O.M. Cannon, M., 25, Stormont Road, Clapham Common, S.W., Vinegar Works Manager.
1913. Cantelo, Robt. C., 204, Frontenac Street, Kingston, Ont., Canada, Chemist.
1891. Carden, Albert J., 20—21, Harp Lane, Gt. Tower Street, London, E.C., Distiller.
1915. Cardwell, David, 50, Alexandra Road South, Manchester, S.W., Chemist.
1893. Carey, Arthur, The Groves, Grassendale Park, near Liverpool, Chemist.
1906. Carey, W. Gordon, Fairholme, Rahy Road, Stockton-on-Tees, Chemist.
1904. Cargill, J. T., c/o Finlay, Fleming, and Co., Rangoon, Burmah, East India Merchant.
1895. Carmichael, Herbert, Bureau of Mines, Victoria, British Columbia, Public Analyst and Assayer.
1884. Carmody, Prof. Patrick, Department of Agriculture, Trinidad, B.W.I., Analytical Chemist.
1897. Carnell, Wm. C., 2136, North Camac Street, Philadelphia, Pa., U.S.A., Chemist.

1906. Caro, Dr. Nikodem, Mcinekestrasse 20, Berlin W. 15, Germany, Analytical Chemist.
1893. Carpenter, Dr. C. C., South Metropolitan Gas Co., 709A, Old Kent Road, London, S.E., Civil Engineer.
1908. Carpenter, Edwin P., Culvert Works, Sheepcote Lane, Battersea, S.W., Manager of Caseis, Ltd.
1900. Carpenter, Frank B., 11, South 12th Street, Richmond, Va., U.S.A., Chemist.
1900. Carpenter, Harry E., c/o Lister's Agricultural Chemical Works, Newark, N.J., U.S.A.
1904. Carr, Francis H., Egmont, Derby Road, Nottingham, Manufacturing Chemist.
1907. Carrier, C. F., jun., Sewaren, N.J., U.S.A., Manufacturing Chemist.
1904. Carter, A., Cuba Street, Petone, Wellington, New Zealand, Works Manager.
1905. Carter, Robert A., 4923, Osage Avenue, Philadelphia, Pa., U.S.A., Chemist.
1895. Carter, Stewart F., 43, Montana Street, North Adams, Mass., U.S.A., Technical Chemist.
1903. Carter, Thomas, West End View, Ravensthorpe, Dewsbury, Yorks. Works Chemist.
1886. Carter, W. Chas., c/o Dominion Iron and Steel Co. Sydney, C.B., Canada, Analytical Chemist.
1911. Carty, Ronald D., The Laboratories, Public Works Ministry Gardens, Cairo, Egypt, Analytical Chemist.
1889. Carulla, F. J. R., 84, Rose Hill Street, Derby, Chemical Manufacturer.
1906. Carveth, Dr. H. R., Niagara Electrochemical Co., Niagara Falls, N.Y., U.S.A., Works Manager.
1914. Casey, John A., Charlemont, Moy, Co. Tyrone, Ireland, Waterproof Manufacturer.
1903. Caspari, Dr. W. A., University College, Gower Street, London, W.C., Chemist and Physicist.
1899. Castro, J. Paul de, 1, Essex Court, Temple, London, E.C., Barrister-at-Law.
1895. Catlin, Chas. A., 133, Hope Street, Providence, R.I., U.S.A., Chemist (Rumford Chemical Works).
1909. Caulkin, Howard A., Mona Villa, Spencer Road, Belper, Analyst.
1906. Cave-Browne-Cave, E. J., c/o Thos. Ness, Ltd., Newcastle Tar Works, Blaydon-on-Tyne, Works Chemist.
1896. Caven, Robt. M., University College, Nottingham, Lecturer in Chemistry.
1914. Caw, Wm., c/o J. Watson and Sons, Whitehall Soap Works, Leeds, Chemist.
O.M. Cawley, G., 82, Victoria Street, Westminster, S.W., Chemical Engineer.
O.M. Cawley, J., 278, Passaic Street, Newark, N.J., U.S.A., Analytical Chemist.
1897. Cawley, Thos. A., British Gelatin Works, Ltd., New Bedford Road, Luton, Gelatin Manufacturer.
1906. Chadsey, Stanley B., 476, Brunswick Avenue, Toronto, Canada, Chemist.
1891. Chadwick, Walter M., Thorneycroft, Westoe, South Shields, Chemical Works Manager.
1912. Chadwick, Walter W., 186, Wellington Street North, Hamilton, Ont., Canada, Chemist.
1910. Challinor, Richard W., Chemical Laboratory, The Technical College, Sydney, N.S.W., Australia, Teacher of Chemistry.
1894. Chaloner, G. W., 26, Eagle Wharf Road, Hoxton, N., Chemical Manager.
1901. Chamberlain, G. E., 641, West Prairie Avenue, Decatur, Ill., U.S.A., Chemist.
1910. Chamhliss, Prof. Hardee, Dept. of Chemistry, Oklahoma A. and M. College, Stillwater, Oklahoma, U.S.A., Professor of Chemistry.
O.M. Chance, A. M., Lawnside, Edgbaston, Birmingham, Chemical Manufacturer.
1912. Chance, Clinton F., Messrs. Chance and Hunt, Ltd., Oldbury, near Birmingham, Managing Director.
1909. Chance, Edwin M., 61, South Penna Avenue. Wilkes-Barre, Pa., U.S.A., Chemist.
O.M. Chandler, Dr. C. F., 51, East 54th Street, New York City, U.S.A., Professor of Chemistry.
1912. Chandler, Lee L., Research Laboratory, Pittsburgh Plate Glass Co., Creighton, Pa., U.S.A., Assistant.
1893. Chaplin, Dr. Edw. M., Public Analyst's Laboratory Wakefield, Yorks. Analytical Chemist.
1890. Chapman, A. Chaston, 8, Duke Street, Aldgate, E.C., Analytical Chemist.
1906. Chapman, Arthur J., Baronsmere, Stanhope Avenue, Church End, Finchley, N., and (Journals) c/o F. Claudet, Ltd., 6 and 7, Coleman Street, London, E.C., Analytical Chemist.
1906. Chapman, E. A., c/o Robert Heath and Sons, Ltd., Norton Works, Stoke-on-Trent, Works Chemist.
O.M. Chapman, Spencer, 36, Mark Lane, E.C., Chemical Manufacturer.
1894. Charlier, A. C. J., 3, Bedford Road, South Tottenham, N., Consulting Chemist.
1900. Chase, March F., 1111, Marquette Building, Chicago, Ill., U.S.A., Chemist.
1889. Chase, R. L., Arnold Printworks, North Adams, Mass., U.S.A., Manager.
1898. Chattock, Herbert E., 23, Apsley Road, Clifton, Bristol. Oilcake Manufacturer.
1910. Chattopadhaya, P. C., 90, Maniktala Main Road, Harrison Road P.O., Calcutta, India, Chemist.
1905. Cheeseman, Frank P., 100, William Street, New York City, U.S.A., Paint Manufacturer.
1901. Cheetham, Howard, 18, St. Ann Street, Manchester, Chartered Patent Agent.
1894. Cheney, John P., Messrs. Cheney Bros., South Manchester, Conn., U.S.A., Chemist and Silk Manufacturer.
1913. Chiaraviglia, Dr. Dino, Via Treviso 7, Rome, Italy, Director, Royal Explosives Laboratory.
1905. Chick, Oliver, 31, Anckland Road, Cranbrook Park, Ilford, Essex, Analytical Chemist.
1890. Chorley, Jno. C., Bewsey, Oxford Road, Birkdale Lancs., Analytical Chemist.
O.M. Christie, J., Levenfield, Alexandria, Scotland, Dyer and Printer.
1903. Christie, John, c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Analytical Chemist.
1914. Christie, John T., c/o Messrs. John Miller and Co., Sandilands Chemical Works, Aberdeen, Analytical Chemist.
1908. Christie, Malcolm, 22, Swinton Road, Baillieston, Scotland, Analytical Chemist.
1910. Christie, Dr. M. G., c/o The Otto-Hilgenstock Coke Oven Co., Post Office House, Leeds, Assistant General Manager.
1898. Christison, Geo., 2, Kelvinside Gardens, Glasgow, Engineer.
1907. Christopher, George, Walkden Works, Verney Road, South Bermondsey, S.E., Consulting Chemist.
1907. Christopher, J. E., Solvay Coke Works, Kiskless, Wigan, Assistant in Charge.
O.M. Chrystal, W. J., 7, West George Street, Glasgow, Chemical Manufacturer.
1908. Chrystall, E. R., c/o Curtis's and Harvey, Ltd., Cliffe at Hoo, Kent, Research Chemist.
O.M. Church, Sir Arthur, K.C.V.O., F.R.S., Shelsley, Kew, Surrey, Professor of Chemistry in the Royal Academy.
1906. Church, Sumner R., c/o Barrett Manufacturing Co., 17, Battery Place, New York City, U.S.A. Chemical Engineer.
1907. Churchill, Wm., Corning Glass Works, Corning, N.Y., U.S.A., Chemist.
1896. Claflin, Alan A., (Communications) 88, Broad Street, Boston; and (Journals) Littleton, Mass., U.S.A., Manufacturing Chemist.
1909. Claflin, Albert W., 190, Waterman Street, Providence, R.I., U.S.A., Manufacturing Druggist.
1900. Clamer, Guilliam H., 46, Richmond Street, Philadelphia, Pa., U.S.A., Chemist.
1885. Clanahan, H. C., 79, Mosley Street, Manchester, Chemical Merchant.
1905. Clapp, Geo. A., 49, Federal Street, Boston, Mass., U.S.A., Chemist.
1891. Clapp, Ralph R., c/o B. P. Clapp Ammonia Co., Providence, R.I., U.S.A., Manager.

1889. Clapperton, J., jun., Analytical Chemist.
1913. Clark, A. Stanley, 94, Sheen Park, Richmond, Surrey, Technical Chemist.
1910. Clark, A. W., c/o Heath and Milligan Manufacturing Co., 1832, South Canal Street, Chicago, Ill., U.S.A., Superintendent.
1904. Clark, Arthur W., c/o Johnson and Johnson, New Brunswick, N.J., U.S.A., Chemist and Bacteriologist.
1908. Clark, Chas. T., 1303. Sixth Street, Bay City, Mich., U.S.A., Manufacturing Chemist.
1913 Clark, Francis W., 35, Wilmington Square, London, W.C., Chemist.
1904. Clark, Prof. Friend E., Central University of Kentucky, Danville, Ky., U.S.A., Professor of Chemistry.
1910. Clark, Henry, 49, Eastcheap, London, E.C., Oil Refiner.
1909. Clark, Hubert A., 83, Amherst Street, Montreal, Canada, Canner.
1900. Clark, Jno., Broadway Works, Millwall Dock, London, E., Manufacturing Chemist.
1906. Clark, M. H., c/o Goodyear's Metallic Rubber Shoe Co., Naugatuck, Conn., U.S.A., Chemist.
1902. Clark, Robt. M., 138, Bath Street, Glasgow, Chemist.
1906. Clark, Wm. B., 11, Fox Street, Greenock, Scotland, Chemist.
1907. Clark, Wm. H., 26, Barry Street, Dunston-on-Tyne, Analytical Chemist.
1912. Clark, William M., Niles Glass Works, Niles, Ohio, U.S.A., Chemist.
1904. Clarke, Alfred R., 613-617, Eastern Avenue, Toronto, Canada, Leather Manufacturer.
1908. Clarke, Arthur F., St. George's, Micheldean, Gloucestershire, Analytical Chemist.
1897. Clarke, Wm. B., c/o Edison-Swan U.E.L. Co., Ltd., Ponders End, N., Electro-Chemist.
1889. Claus, Wm. H., c/o Claus and Co., Ltd., Clayton, Manchester, Manufacturing Chemist.
1909. Clayton, Ellis, 7, Deerpark Road, Belfast, Ireland, Lecturer on Bleaching, Dyeing, and Printing.
1895. Clayton, Dr. G. C., Cronghton, near Chester.
1909. Clayton, H., "The Brae," Station Road, Crayford, Kent, Technical Chemist.
1894. Clayton, Robt. H., 1, Parkfield Road, Didsburys Manchester, Chemist.
1910. Clayton, Will, Cliffe House, Accrington, Works Chemist.
1905. Clayton, W. E., Navy Victualling Yard, Kowloon, Hong Kong, Superintendent.
1907. Clement, Leonard, 11, Agnew Street, Lytham, Lancs., Chemist.
1893. Clemes, J. H., Cheriton, Newquay, Cornwall.
1905. Clexton, Thos. J., 285, Congress Street, Boston, Mass, U.S.A., Manager (A. Klipstein and Co.).
1906. Clifford, Jos., Laboratory, Public Works Ministry Gardens, Cairo, Egypt, Chemist.
1913. Clifford, Sydney G., 51, Peak Hill, Sydenham, S.E., Analytical Chemist.
1900. Clifford, Wm., Sewage Outfall Works, Wolverhampton, Sewage Works Manager.
O.M. Cloud, T. C., 20, Bucklersbury, London, E.C., Motallurgist.
O.M. Clowes, Dr. F., The Grange, College Road, Dulwich, S.E.; retain Journals; Chemist.
1891. Clutton, J. H., Fonderie Mines de l'Aude, Villanière par Lastours (Aude), France, Assayer.
1911. Clymer, Wm. R., Publicity Department, National Carbon Co., Cleveland, Ohio, U.S.A., Manager.
1899. Coates, Chas. E., jun., Louisiana State University, Baton Rouge, La., U.S.A., Professor of Chemistry.
1911. Coates, Jos. E., The University, Edgbaston, Birmingham, Lecturer.
1888. Coats, Jno. T., 105, Broughton Street. Edinburgh, Manufacturing Chemist.
1915. Cobb, Ernest B., c/o Standard Oil Co. (N.J.), Bayonne, New Jersey, U.S.A.
1893. Cobb, Prof. Jno. W., The University, Leeds, Prof. of Coal Gas and Fuel Industries.
1894. Cohlentz, Dr. Virgil, 23, Vine Street, Brooklyn, N.Y., U.S.A., Research Chemist (R. R. Squibb and Co.).
1899. Cochran, Alfred, 559, Madison Street, Brooklyn, N.Y., U.S.A., Chemist.
1911. Cochrane, Capt. J. B., Royal Military College, Kingston, Ontario, Canada, Professor of Physics and Chemistry.
1901. Cockburn, John A., Mayville, Stevenston, Ayrshire, Analytical Chemist.
1902. Cocking, Allan T., c/o Kynoch, Ltd., Lion Works, Witton, Birmingham, Ammunition Manufacturer.
1905. Coes, Chas. S., 1024, East River Street, Hyde Park, Mass., U.S.A., Oil Chemist.
1903. Coggeshall, Dr. G. W., 1850, Mintwood Place, Washington, D.C., U.S.A., Chemical Engineer.
1887. Coghill, P. de G., Borax Works, Old Swan, Liverpool, Technical Chemist.
1884. Cogswell, W. B., Syracuse, N.Y., U.S.A., Chemical Engineer.
O.M. Cohen, Dr. J. B., 1, North Grange Mount, Headingley, Leeds, Professor of Organic Chemistry.
1897. Cohn, Alfred I., 122, East 74th Street, New York City, U.S.A., Chemist.
1901. Cohn, Sigmund, 13, Dutch Street, New York City, U.S.A., Metallurgical Chemist.
1904. Cohoe, Prof. W. P., 50, East 41st Street, New York City, U.S.A., Professor of Chemistry.
1891. Colby, Albert L., 447, Lehigh Street, South Bethlehem, Pa., U.S.A., Metallurgical Engineer.
1899. Colby, E. A., Baker Platinum Works, Newark, N.J., U.S.A., Metallurgical Chemist.
O.M. Colby, W. H., Cairn Villa, St. Branock's Road, Ilfracombe.
1893. Coleman, W. H., 1, Athole Gardens, Newlands, Glasgow, Chemical Engineer.
1913. Colgate, R. T., 25, Denmark Road, Reading, Works Chemist.
1905. Collett, John H., Sunnycroft, Tuffley, and (Juls.) The Librarian, Free Library, Gloucester, Chemical Manufacturer.
1887. Collett, J. M., Wynstone Place, Brookthorpe, Gloucester, Chemical Manufacturer.
1901. Colley, Bernard T., c/o Braden Copper Co., Rancagua, Chile, South America, Superintendent.
1908. Collier, F. C., 457, Lansdowne Avenue, Westmount, Montreal, Canada, Analytical Chemist.
1903. Collier, Pierre, Companhia Industrial Pernambucana, Pernambuco, Brazil, Civil Engineer.
1893. Collin, Dr. C. A., Fergusiie Threadworks, Paisley, Textile Chemist.
1913. Collinge, H. G., c/o Naegeli and Co., Rua Theophilo Ottoni 21 (Caixa 562), Rio de Janeiro, Brazil, Technical Chemist.
1898. Collingridge, Frank, Highstone, New Road, Llanelly, South Wales, Chemist.
1899. Collins, S. Hoare, 9, Cavendish Place, Newcastle-on-Tyne, Agricultural Chemist.
1888. Collins, W. Hepworth. *See* Hepworth Collins, W.
1913. Collinson, R. W., c/o Messrs. J. and J. Colman, Ltd., Starch Dept., Carrow Works, Norwich, Starch Manufacturer.
1899. Collis, Walter T., Parkhurst, St. Peter's Road, Harborne, Birmingham, Chemist.
1910. Collitt, Bernard, Chem. Laboratory, Messrs. Ruston, Proctor, and Co., Ltd., Lincoln, Chemist.
1910. Colman, Fred. J., c/o Brotherton and Co., Ltd., Wear Tar Works, Sunderland, Chemist.
1891. Colman, Dr. H. G., Woodthorpe, New Malden, Surrey, Analytical Chemist.
1892. Colquhoun, Lndovic, Dynamite Factory, Modderfontein, Transvaal, Analytical Chemist.
1894. Colquhoun, W., Endcliffe, Endcliffe Crescent, Sheffield, Engineer.
1901. Colwell, J. Kear, Finsbury Town Hall, Rosebery Avenue, E.C., Analytical and Consulting Chemist.
1906. Comber, A. W., 23, Courtenay Gardens, Upminster Essex, Metallurgical Chemist.

1900. Comey, Dr. Arthur M., Upland Avenue, opposite Summit Street, Chester, Pa., U.S.A., Technical Chemist.
1911. Comey, Robert H., Wenonah, N.J., U.S.A., Bleacher.
1906. Compton, Miss N. J., Library, University of Nebraska, Lincoln, Neb., U.S.A., Librarian.
1901. Connah, Jas., Laboratory, Custom House, London, E.C., Government Analyst.
1891. Conradson, Pontus H., Galena Oil Works, Franklin, Pa., U.S.A., Analytical Chemist.
1889. Conroy, Dr. Jas. T., 9, The Serpentine, Grassendale, Liverpool, Chemist.
1887. Constable, W. H., Australian Alum Works, Runcorn, Analytical Chemist.
1909. Cook, E. Bernard, 23, Cross Street, Finsbury, London, E.C., Manufacturing Chemist.
O.M. Cook, H. J., The Firs, Woodford Green, Essex, Soap Manufacturer.
1903. Cook, Jas. W., London and Provincial Dye Works, Hackney Wick, N.E., Dyer.
1898. Cook, Thos. Alex., East London Soap Works, Bow, E., Soapmaker.
1899. Cook, Walter G., 9, Hendon Lane, Finchley, N., Analytical Chemist.
1907. Cooke, J. J. Verdin, 9, James Street, Liverpool, Salt Manufacturer.
1904. Cooke, W. Ternent, The University, Adelaide, South Australia, Lecturer in Chemistry.
1910. Coombs, Frank A., Technical College, Sydney, N.S.W., Australia, Lecturer on Tanning.
1913. Cooper, G. Stanley, 92, Harcourt Road, Sheffield, Chemist.
1910. Cooper, Leonard H., Royal Crown Soap Co., Calgary, Alberta, Canada, Chemist.
1901. Cooper, T. S., Beckfoot, Birch Hall Lane, Manchester, Calico Printing Chemist
1891. Cooper, Walter J., The Elms, Lavernock, nr. Penarth, South Wales, Cement Works Manager.
1890. Corcoran, Bryan, 43, Croham Park Avenue, South Croydon, Chemical Engineer.
1914. Corder, Walter S., Messrs. Williamson and Corder, Ltd., Low Walker, Newcastle-on-Tyne, Chemical Manufacturer.
1899. Cornelison, Dr. Robt. W., 275, West Summit Street, Somerville, N.J., U.S.A., Consulting Chemist.
1909. Cornell, Fred, 16, Place Royal, Montreal, Canada, Chemical Merchant.
1894. Coste, J. H., 2, Savoy Hill, Victoria Embankment, W.C., and (Journals) Utopia, Gloucester Road, Teddington, Chemist (Public Health Dept., L.C.C.).
1913. Cotterill, John W., 9, Broad Street Corner, Birmingham, Analyst.
1912. Coupe, Geoffrey, 43, Hampton Road, Forest Gate, E., Chemist.
1914. Cousins, F. G., 1, St. Cuthbert's Place, North Road, Durham, Science Master.
1894. Cousins, W. J., 55, Clerkenwell Close, London, E.C., Consulting Chemist and Director.
1909. Coventry, Bernard O., Lahore, Punjab, India, Deputy Commissioner of Forests.
1903. Cowan, A. Wallace, Bayfield, Bowdon, Cheshire, Analytical Chemist.
1906. Cowan, George D., Bridge House, Bridge Road, Millwall, E., Manager, Desilverising Works.
1912. Cowan, H. W., Bell Filtration Co., Ltd., 305, Kent Building, Toronto, Canada, Water and Sewage Specialist.
1893. Cowan, W. J., 12, Park Avenue, Wood Green, N., Fine Colour Manufacturer.
1910. Coward, Hubert F., 216, Plymouth Grove, Manchester, Lecturer in Chemistry.
1897. Cowburn, Arthur W., 20, Mount Street, Manchester, Chemical Merchant and Analytical Chemist.
1907. Cowburn, J. Robert, 10, Eastwood Road, South Woodford, Essex, Technical Chemist.
1891. Cowper-Coles, Sherard Osborn, 1 and 2, Old Pye Street, Westminster, S.W., and (Jnls.) The Cottage, French Street, Sunbury-on-Thames, Metallurgical Engineer.
1905. Cox, Harold N., c/o Lalance and Grosjean Mfg. Co., Woodhaven, N.Y., U.S.A., Chemist.
1884. Craig, Geo., Chemical Laboratory, 95, Bath Street, Glasgow, Technical Chemist.
1895. Craig, Dr. Thos. J. I., c/o Peter Spence and Sons, Ltd., Alum Works, Manchester, Chemist.
1908. Craig, Wm. J., c/o Rio Tinto Co., Casa Colon, Huelva, Spain, Analytical Chemist.
1911. Crake, Ralph V., British South African Explosives Co., Dynamite Factory, Modderfontein, Transvaal, Chemist.
1901. Crane, Fred. D., 28, Hillside Avenue, Montclair, N.J., U.S.A., Consulting Chemist.
1902. Crane, Jasper E., c/o The Arlington Co., Arlington, N.J., U.S.A., Chemist.
1903. Cranmer, Ridgeway, 170, 88th Street, Bay Ridge, Brooklyn, N.Y., U.S.A., Chemist.
1902. Craven, Alfred B., Northcote, Thorpe Road, Selby, Yorks, Analytical Chemist.
1906. Craven, J. A., 119, Moorside, Armley, Leeds, Chemist.
1891. Craven, Jno., The Ark, South Bersted, Bognor, Sussex, Chemist.
1906. Craven, John I., Niederwald, Hebers Ghyll, Ilkley, Yorks, Chemist and Salesman.
O.M. Crawford, D., Langdale's Chemical Manure Co., Ltd., St. Lawrence, Newcastle-on-Tyne, Manager.
1913. Crawford, John, c/o Lothian, 24, Briar Bank Terrace, Edinburgh, Works Chemist.
1908. Crawford, Lawrence, 4, Eastfield Road, Dumfries, Scotland, Analytical Chemist.
1890. Crawshaw, E., 25, Tollington Park, London, N., Dye Merchant.
1914. Creese, Guy T., 2, Poplar Street, Danvers, Mass., U.S.A., Leather Manufacturer.
O.M. Cresswell, C. G., Ermyngarth, Ashtead, Surrey; and Broadway Chambers, Westminster, S.W., Chemist.
1901. Crihb, Cecil H., 136, Shaftesbury Avenue, London, W., Analytical and Consulting Chemist.
1909. Crichton, Charles, Kleinfontein Group C.A., Box 2, Benoni, Transvaal, Assayer.
1908. Crighton, Adam M., "London Place," Agecroft Print Works, Pendleton, Manchester, Calico Printer's Chemist.
1910. Crighton, David T., Nobel House, 195, West George Street, Glasgow, Buying Manager.
1905. Crighton, W. H., c/o Ore Concentration Co., Ltd., Glebe Road, Kingsland Road, London, N.E., Chemist.
1890. Criper, Wm. R., c/o Messrs. D. Waldie and Co., Konnagar, near Calcutta, India, Manufacturing Chemist.
1911. Croasdell, Jas. F., 108, Burnt Ash Road, Lee, S.E., Engineer.
1901. Cronquist, G. W., Torekow, Sweden, Consulting Ceramic Engineer.
O.M. Crookes, Sir Wm., O.M., F.R.S., 7, Kensington Park Gardens, Notting Hill, W., Analytical Chemist.
1896. Crosby, Thos., Llanelly Steelworks, Llanelly, South Wales, Metallurgist.
O.M. Crosfield, A. L., 46, Bidston Road, Oxton, Birkenhead; (Journals) c/o Prof. B. Moore, Biochemical Dept., The University, Liverpool, Analytical Chemist and Assayer.
1896. Crosfield, Capt. G. R., Lodge Lane, Warrington, Soap Manufacturer.
1908. Crosland, Percy F., Century Dye Works, Elland, Yorks, Technical Chemist.
1884. Cross, C. F., 4, New Court, Lincoln's Inn, London, W.C., Analytical Chemist.
1894. Crossley, Prof. Arthur W., F.R.S., King's College, Strand, and (Jnls.) 46, Lindfield Gardens, Hampstead, N.W., Professor of Chemistry.
1904. Crossley, T. Linsey, 318, Laganchetière Street West, Montreal, Canada, Technical Chemist.
1908. Croston, Henry, 583, Leonard Street, Brooklyn, N.Y., U.S.A., Foreman.
1894. Crow, Henry W., Hart's Lane, North Street, Barking, E., Tar Distiller.

1884. Crow, Dr. J. K., Ivydene, Westcombe Park Road, Blackheath, S.E., Technical Chemist.
1883. Crowther, Horace W., The Beeches, West Bromwich, Technical Chemist.
1906. Crowther, R. E., c/o Ferguson Bros., Ltd., Holme Head, Carlisle, Chemist.
1912. Cruikshanks, Dr. Geo. S., Royal Technical College, Glasgow, Chemist.
1906. Cruser, Dr. Fred. Van D., c/o The Diamond Match Co., Oswego, N.Y., U.S.A., Chemical Engineer.
1892. Cullen, Wm., Dynamite Factory, Modderfontein, Transvaal, South Africa, Chemist.
1903. Cullen, W. H., The Castner-Kellner Alkali Co., Ltd., Wallsend-on-Tyne, Engineer.
1897. Cnlmann, Dr. J., c/o G. Siegle Co., Rosebank, Staten Is., N.Y., U.S.A., Chemist and Colonrist.
1883. Cnming, James, jun., Chemical Works, Yarraville, Melbourne, Australia, Chemical and Fertiliser Manufacturer.
1912. Cnming, Wm. F., c/o Cuming, Smith, and Co. Proprietary, Ltd., Yarraville, Victoria, Australia, Manufacturing Chemist.
1907. Cunningham, James E., Minas Peña del Hierro, Provincia de Huelva, Spain, Analytical Chemist.
1915. Cunningham, Thos. R., P.O. Box 665, Falls Station, Niagara Falls, N.Y., U.S.A., Chemist.
O.M. Curphey, W. S., 87, Canfield Gardens, South Hampstead, N.W., Chief Alkali Works Inspector.
1898. Curtis, Marvin, 103, Front Street, San Francisco, Cal., U.S.A., Wine Chemist.
1903. Cushing, Robt. P., 313, Saurens Street, Olean, N.Y., U.S.A., Chemist.
1902. Cuthnsh, Chas. G., 59, Byne Road, Sydenham, Kent, Electrical Engineer.
1899. Cutler, Fred. F., 166, Essex Street, Boston, Mass., U.S.A., Publisher.
1914. Cutler, J. Vernell, Technical Chemist.
1913. Cutts, H. Cyril, Brooklyn, Private Road, Sherwood, Nottingham, Embroidery Manufacturer.
1904. Cutts, Henry E., c/o Stillwell and Gladding, 181, Front Street, New York City, U.S.A., Technical Chemist.

## D

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1911. Dager, Herman J., 278, Jarvis Street, Toronto, Canada, Dominion Food Inspector.
1897. Dains, Herbert H., c/o J. E. Ferguson, 2, Union Court, London, E.C., Analytical Chemist.
1884. Daniell, Louis C., Royal Standard Brewery, Tamworth, New South Wales, Brewer.
1904. Danker, Dan. J., 73, Dean Road, Brookline, Mass., U.S.A., Dyestuff and Chemical Merchant.
1903. Dannenbaum, Dr. H., c/o National Ammonia Co., Frankford, Philadelphia, Pa., U.S.A., Secretary and Treasurer.
1885. Darby, Jno. H., Howard Chambers, 155, Norfolk Street, Sheffield, Ironmaster.
1911. David, Edward J., 249, Wood Avenue, Tottenville, Staten Is., N.Y., U.S.A., Chemist and Assayer.
1900. Davidson, Alex., 173, Colinton Road, Edinburgh, Analytical Chemist.
1899. Davidson, Charles, 65, Cadder Street, Pollokshields, Glasgow, Analytical Chemist.
1901. Davidson, G. M., Chicago and N.W. Railroad Shops, P.O. Station E., Chicago, Ill., U.S.A., Chemist.
1883. Davidson, J. E., 40, Percy Gardens, Tynemouth, Chemical Manufacturer.
1891. Davidson, Richard, 133, Victoria Road, Dundee, Oil Merchant's Clerk.
O.M. Davidson, R. Holden, c/o United Alkali Co., Ltd., Ammonia Soda Works, Fleetwood, Manager.
1904. Davidson, Robert, c/o Dalgety and Co., Ltd., 15, Bent Street, Sydney, N.S.W., Australia.
1911. Davidson, Thos. A., 57, Strathyre Avenue, Norbury, S.W, Chemist and Varnish Expert.
1905. Davidson, Dr. Wm. B., City Gas Works, Nechells, Birmingham, Chemist.
1906. Davies, Harry R., 80, Prince Street, Jamaica Plain, Mass., U.S.A., Chemist.
1898. Davies, Herbert E., The Laboratory, 28, Chapel Street, Liverpool, Analytical Chemist.
1907. Davies, James, 12, Harefield Road, Brockley, London, S.E., Scientific Apparatus Maker.
1912. Davies, Jas. Gordon, c/o Curtis's and Harvey, Ltd., Powder Mills, Tonbridge, Kent, Chemist.
1911. Davies, Jas. H., c/o Lever Bros., Ltd., Royal Liver Building, Liverpool, Chemist.
1896. Davies, Llewellyn J., 103, Bute Road, Cardiff, Analytical and Consulting Chemist.
1886. Davies, M. L., Standard Chemical, Iron, and Lumber Co., Toronto, Canada, General Manager.
1897. Davies, Saml. H., c/o Rowntree and Co., Ltd., The Cocoa Works, York, Research Chemist.
1908. Davies, T. H., c/o John Cox and Co.'s Successors, Stillhouse Lane, Bedminster, Bristol, Tanner.
O.M. Davis, A. R., 27, Wellington Road, Heaton Chapel, Stockport, Analytical Chemist.
1901 Davis, Bernard F., c/o Ore Trading Co., Casilla 112D, Santiago, Chile, Metallurgical Engineer.
1902. Davis, Charles B., c/o National Brewers' Academy, 402, West 23rd Street, New York City, U.S.A., Technical Chemist.
1912. Davis, E. Gordon, c/o Messrs. Curtis's and Harvey, Ltd., Cliffe at Hoo, Kent, Research Chemist.
1914. Davis, Eric N., 4, Brookwood Avenue, Barnes, S.W., Technical Journalist.
1908. Davis, G. Kevillo, 265, Strand, London, W C, Chemical Engineer.
O.M. Davis, H. W., 18, Crescent Road, Kingston-on-Thames, Analytical Chemist.
1897. Davis, Wm. A., 7, Carlton Bank, Harpenden, Herts, Chemist.
1911. Davis, Wm. C., 6, Park Road, West Smethwick, near Birmingham, Chemist.
1900. Daw, Fred W., Duffryn House, Ebbw Vale, Mon., Metallurgical Chemist.
O.M. Dawson, C. A., 32, Elm Hall Drive, Mossley Hill, Liverpool, Technical Chemist.
1915. Dawson, Reginald D., Chemical Dept., Southern Outfall Works, Crossness, Abbey Wood, Kent, Chemist.
1886. Dawson, W. Haywood, British Alizarin Co., Ltd., Silvertown, E., and (Journals) 15, Wrottesley Road, Woolwich, S.E., Technical Chemist.
1901. Day, Dr. David T., U.S. Geological Survey, Washington, D.C., U.S.A., Geologist.
1913. Day, Frank E., c/o Condensed Milk Co. of Ireland, Lansdowne, Limerick, Ireland, Analytical Chemist.
1912. Day, G. A. C., Casilla No. 417, Lima, Peru (*viâ* New York), Oil Mill Manager.
O.M. Deacon, H. Wade, 8, Ullet Road, Liverpool; and (Jnls.) c/o C. E. Tyers, 186, Derby Road, Farnworth, Widnes, Alkali Manufacturer.
O.M. Deakin, H. T., Dewburst, Egerton, near Bolton, Dyer.
1913. Deakin, J. Bartram, c/o Guest, Keen, and Nettlefolds, Ltd., By-Product Coke Ovens, Cwmbran, Mon., Coke Oven Manager.
1911. Dean, Arthur L., College of Hawaii, Honolulu, H.I., U.S.A., Assistant Prof. of Industrial Chemistry.
1906. Dean, Harry, Armstrong College, Newcastle-on-Tyne, Demonstrator.
1892. Deaville, B., Beech Avenue, Nottingham Manufacturing Chemist.
1899. De Castro, J. Paul. *See* Castro, J. Paul de.
1902. De Cew, J. A., 903, McGill Building, Montreal, Canada, Chemical Engineer.
1893. De Clerck, Maurice, Heule-lez-Courtrai, Belginm.
1884. Deering, W. H., I.S.O., Beauworth, Moretonhampstead, Devon, late Chemist to War Department.
1900. Deerr, Noel F., Jobaho, Oriente, Cuba, Analytical Chemist.
1902. Deghuée, Dr. Jos. A., 39, West 38th Street, New York City, U.S.A., Chemist.

1911. Dehn, Dr. Frank B., Broad Sanctuary Chambers, Westminster, S.W., Chemist and Patent Agent.
1901. De Jonge, Cornelius, 36, Doughty Street, Brooklyn, N.Y., U.S.A., Pharmaceutical Chemist.
1893. Delahâye, Philibert, 94, Rue St. Lazare, Paris (IX.), Gas Engineer.
1909. De Laire, Edgar, 129, Quai de Moulineaux. Issy, Seine, France, Industriel.
1901. Delany, Chas., c/o Elliott Bros., Ltd., O'Connell Street, Sydney, N.S.W., Australia, Chemist.
1908. Dellschaft, Dr. F. H., Winnington, Northwich, Cheshire, Manufacturing Chemist.
1910. De Meeus, Etienne, Beacon Falls, Conn., U.S.A., Chemist.
1888. Dempsey, Geo. C., 165, Market Street, Lowell, Mass., U.S.A., Chemist.
1909. Demuth, Rudolph, 68. Salusbury Road. London, N.W., Manufacturer.
1899. Denham, Wm. S., The United College, St. Andrews, Scotland.
1913. Denington, R. C., 69, Dover Road, South Wanstead, Essex, Research Chemist.
1891. Denison, Joseph R., Valley Dyeworks, Bradford, Yorks, Analytical Chemist.
1911. Dennis, Louis, c/o Brothertons Ltd., Church Road, Litherland, Liverpool, Works Chemist.
1908. Dennis, Martin, 859, Summer Avenue, Newark, N.J., U.S.A., Manufacturing Chemist.
1907. Dennison, Henry S., c/o Dennison Manufacturing Co., Framingham, Mass., U.S.A., Manufacturer.
1898. Dent, Dr. Frankland, Government Analyst's Dept., Singapore, S.S., Government Analyst.
1912. Depierres, Gaston, The Indestructible Paint Co., King's House, King Street, Cheapside, London, E.C., Managing Director.
1905. Derby, Wallace G., c/o Nichols Copper Co., Laurel Hill, New York City, U.S.A., Assayer.
1913. Desch, Dr. Cecil H., Metallurgical Dept., The University, Glasgow, Lecturer.
1912. Dettmann, A. H., Stuart Street, Longueville, Sydney, N.S.W., Leather Manufacturer.
1914. Detwiler, Jas. G., La Tourette Hotel, Bergen Point, Bayonne, N.J., U.S.A., Chemist.
1906. Deverell, Louis C., 1, Shortlands Grove, Shortlands, Kent, Chief Chemist.
1898. Dewar, Alex. H., c/o The Linoleum Manufacturing Co., Staines, Middlesex, Chemist.
O.M. Dewar, Sir J., F.R.S., 21, Albemarle Street, London, W., Professor of Chemistry and Physics.
1889. Dewey, Fred. P., 1801, Summit Plain, N.W., Washington, D.C., U.S.A., Metallurgist.
1904. Dewhirst, J. A., Imperial Chambers, Halifax, Yorks, Analyst.
1909. Dewhirst, Wm. B., Gen. Delivery, Cleveland, Ohio, U.S.A., Technical and Engineering Chemist.
1903. Diamond, Wm., La Noric, Marley Hill, Co. Durham, Works Manager.
1913. Diaz-Ossa, Prof. Belisario, Casilla 962, Santiago, Chile, Prof. of Chemistry.
O.M. Dibdin, W. J., 2, Edinburgh Mansions, Howick Place, S.W., Analytical Chemist.
1913. Dick, James, c/o Canadian Explosives, Ltd., Beloeil Station, P.Q., Canada, Superintendent.
1902. Dick, John, Wharf Road, Cubitt Town, London, E., Manager and Chemist.
1904. Dick, W. D., c/o Hugh Baird and Sons, 29, St. Vincent Place, Glasgow, Analytical Chemist.
1898. Dickenson, F. M., c/o Broken Hill Proprietary Co., 3, Great Winchester Street, London, E.C., Secretary.
1901. Dickenson-Gair, C. J. *See under* Gair.
1893. Dickerson, E. N., 141, Broadway, New York City, U.S.A., Lawyer.
O.M. Dickinson, A. J., 178, Lewisham High Road, Brockley, S.E., Tar Distiller.
1905. Dickinson, Cyril, Southwark Town Hall, Walworth Road, London, S.E., Analytical Chemist.
1914. Dickson, J. M., 36, Leopold Street, Toronto, Canada, Manager.
1898. Dickson, Samuel, 26, Tothill Street, Westminster, S.W., Analytical Chemist.
1899. Dieckmann, Dr. Otto, 1180, Harrison Avenue, Cincinnati, Ohio, U.S.A., Chemist.
1914. Diehl, Dr. L. H., 703, Salisbury House, London Wall, London, E.C., Metallurgical Chemist.
1908. Dickman, Dr. George C., 115, West 68th Street, New York City, U.S.A., Professor of Pharmacy.
1894. Diestel, Wm., 117, Hudson Street, New York City, U.S.A., Dyestuff Importer.
1908. Dill, Colby, Ranway Avenue, Woodbridge, N.J., U.S.A., Chemist.
1898. Dillon, Wm., The Lomas Gelatine Works, Prince's Rock, Plymouth, Oil, Colour, and Varnish Manufacturer.
1911. Dissosway, Thurston N., 23, Vine Street, Brooklyn, N.Y., U.S.A., Chemist.
1903. Divine, Robt. E., 63, Richton Avenue, Highland Park, Mich., U.S.A., Chemist.
1899. Dixon, Fred. W., P.O. Box 43, Jamestown, N.Y., U.S.A., Dyer.
1888. Dixon, Prof. Harold B., F.R.S., Owens College, Manchester, Professor of Chemistry.
1902. Dixon, Wm. A., Reiby Chambers, Reiby Lane, Circular Quay, Sydney, N.S.W., Australia, Public Analyst and Assayer.
1909. Dixon, W. H., c/o Bryant and May, Ltd., Fairfield Works, Bow, London, E., Match Manufacturer.
1892. Dobb, Thos., c/o J. T. Dobb and Son, West Bar, Sheffield, Pharmaceutical Chemist.
O.M. Dobbie, Sir J. J., F.R.S., Government Laboratory, Clement's Inn Passage, London, W.C., and (Jnls.) 4, Vicarage Gate, Kensington, W., Director.
O.M. Dobbin, Dr. L., Chemical Laboratory, University, Edinburgh, Professor of Chemistry.
1908. Dobbs, Ernest J., 16–17, Devonshire Square, Bishopsgate, London, E.C., Analytical Chemist.
1914. Dobson, Fred. W., Castle Grove, Nottingham, Lace Dyer and Dresser.
1913. Dobson, James, Holme Rook, Birch Lane, Longsight, Manchester, Technical Chemist.
1907. Dodd, Arthur J., Meadholme, Blackheath Park, S.E., Oil Manufacturer.
1915. Dodd, A. Scott, Laboratory, 20, Stafford Street, Edinburgh, Public Analyst.
1889. Dodd, W. Ralph, Burton Grange, Goff's Oak, near Cheshunt, Chemical Works Manager.
1913. Dodds, Herbert H., c/o Kynoch, Ltd., Umbogintwini, Natal, Explosives Chemist.
1906. Dodds, Thos., c/o Reckitt and Sons, Ltd., and (Journals) 7, The Oval, Garden Village, Hull, Works Manager and Chemist.
1900. Dodge, Dr. Francis D., 69, Avenue A., Bayonne, N.J., U.S.A., Chemist.
1906. Dodsworth, Welter A. Journal of Commerce, 32, Broadway, New York City, U.S.A., Editor.
1897. Doerflinger, Wm. F., Rosebank, Staten Island, N.Y., U.S.A., Research Chemist.
1897. Dohme, Dr. Alf. R. L., Messrs. Sharp and Dohme, Baltimore, Md., U.S.A., Manufacturing Chemist.
1905. Dolan, H., Westbourne, Belvoir Road, Lower Walton, Warrington, Chemist.
1914. Domingues, Adolfo, *see* Miralles, A. D.
1914. Donald, James R., 318, Laganchetière Street West, Montreal, Canada, Chemical Engineer.
1903. Donald, Dr. Jas. T., 318, Lagauchetière Street West, Montreal, Canada, Consulting Chemist.
1912. Donald, R. M., c/o Lever Bros. Co., 174, Broadway, Cambridge, Mass., U.S.A., Soapworks Manager.
1900. Donald, Wm, Ridgefield Park, Bergen Co., N.J., U.S.A., Assayer and Chemist.
1913. Donaldson, Richard, 63, Waverley Gardens, Crossmyloof, Glasgow, Assistant Manager.
1902. Donaldson, Thos., Beechcroft, Ardrossan Road, Saltcoats, Scotland, Chemist.
1905. Donnan, Prof. F. G., F.R.S., Chemical Laboratories University College, Gower Street, London, W.C. Professor of Physical Chemistry.
1886. Doolittle, Orrin S., 388, Palisade Avenue, Yonkers N.Y., U.S.A., Chemist.
1905. Doolittle, Roscoe E., 109, Hillside Avenue, Glen Ridge, N.J., U.S.A., Chemist.

1900. Dore, Jas., Copper Works, High Street, Bromley-by-Bow, E., Distiller's Engineer.
1911. Dorée, Dr. Charles, 58, Gore Road, South Hackney, London, N.E., Head of Chemistry Department, Borough Polytechnic.
1896. Doremus, Dr. Chas. A., 55, West 53rd Street, New York City, U.S.A., Professor of Chemistry.
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1911. Dougall, Jas. S. N., 305, Manufacturers Street, Montreal, Canada, Varnish Manufacturer.
1897. Douglas, Geo., Farfield Hall, Addingham, Yorks, Dyer.
1894. Douglas, Loudon M., Douglas Wharf, Putney, S.W., Chemical Manufacturer.
1909. Douglas, Robt. P., Prudential Buildings, Nelson Square, Bolton, Consulting Chemist.
1884. Douglas, William, Grafton House, Berkhamsted, Herts., Chemical Engineer.
1900. Doulton, H. Lewis, Royal Doulton Potteries, Lambeth, S.E., Potter.
1900. Dow, Allan W., 126, Joralemon Street, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1898. Dow, Herbert H., Midland, Mich., U.S.A., Manufacturing Chemist.
1908. Dow, John W., 504, Park Avenue West, Mansfield, Ohio, U.S.A., Manufacturing Chemist.
1905. Dowhiggin, James, Craiglands, Albert Park, Lancaster, Chemist.
1913. Dowell, Henry I., Brooklands, Forest Rise, Upper Walthamatow, N.E., Chemist.
1912. Doxey, Carl W., c/o Whalley Abbey Printing Co., Whalley, near Blackburn, Printworks Chemist.
1901. Doxrud, Christian, Technical School, Christiania, Norway, Professor of Chemical Technology.
1907. Doyle, B. W., 245, Lindell Avenue, Leominster, Mass., U.S.A., Manufacturer.
1902. Drake, Bryant S., 5830, Colby Street, Oakland, Cal., U.S.A., Chemist.
1911. Drake, Joseph W. D., Three Mills Distillery, Bromley-by-Bow, London, E., Distillery Brewer.
1914. Drew, John M., Lower House, Burnley, Lancashire, Calico Printer.
1906. Drew, W. Newton, Raincliffe, Ecclesfield, near Sheffield, Chemical Manufacturer.
1896. Drewsen, Dr. Viggo B., 5, Beekman Street, New York City, U.S.A., Wood Pulp and Paper Expert,
O.M. Dreyfus, Dr. C., Claremont, Fallowfield, Manchester. Dye Manufacturer.
1904. Dreyfus, Dr. L. A., Maple Avenue, Roseбank, S.I., N.Y., U.S.A., Chemist.
1893. Droyfus, S., Thorncliffe Villa, Windmill Lane, Denton, near Manchester, Chemist.
1899. Dreyfus, Dr. Wm., 57, East 96th Street, New York City, U.S.A., Chemist.
1898. Drummond, Dr. Isaac W., 436, West 22nd Street, New York City, U.S.A., Chemist.
1910. Drury, Chas. Dru, Hendon Gas Works, Sunderland, Engineer.
1899. Ducas, B. P., 25-27, South William Street, New York City, U.S.A., Chemical and Dyestuff Importer.
1905. Duché, E., 6, Eastcheap, London, E.C., Merchant.
1909. Duchemin, Réné P., 6, Rue Chanoinesse, Paris IV., France, Chemical Engineer.
1897. Duckham, Alex., Phœnix Wharf, West Ferry Road, Millwall, E., and (Jnls.) Vanbrugh Castle, Blackheath, S.E., Chemical Manufacturer.
1915. Duckham, Arthur M., Palace Chambers, Westminster, S.W., Engineer.
1905. Duckworth, Harry S., Garner Printworks and Bleachery, Garnerville, Rockland Co., N.Y. U.S.A., Printworks Chemist.
1913. Duff, Alex. R., 211, Fern Avenue, Toronto, Canada, Rubber Chemist.
1899. Duff, Wm. S., Merrie Lands, Westbury Road, Buckhurst Hill, Essex, Manufacturing Chemist.
1905. Duffus, W. B., Riddersk Mine, Oust Kamenogorsk, Semipalatinsk District, Siberia, Russia, Chemist.
1901. Dufty, Lawrence, 92, Tom Lane, Nether Green, Sheffield, Analytical Chemist.
1905. Duggan, Edw. J., c/o Brewer and Co., 95, William Street, New York City, U.S.A., Vice-President.
O.M. Duggan, T. R., 52, East 41st Street, New York City, U.S.A., Analytical Chemist.
1898. Duisberg, Dr. Carl, The Bayer Co., Ltd. (Journals), Farbenfabrik, Leverkusen, bei Cöln a/R., Germany; (subscriptions) 19, St. Dunstan's Hill, London, E.C., Chemist and Managing Director.
1888. Dukes, T. William, Box 10, Vrijheid, South Africa, Merchant.
1905. Duncalfe, Roger, Forge Mills, Bestwood Colliery, Nottingham, Glue Manufacturer.
1889. Duncan, Arthur W., c/o J. Woolley, Sons and Co., Ltd., Victoria Bridge, Manchester, Analytical Chemist.
1909. Duncan, Jas., c/o Steel Bros. and Co., Ltd., 6, Fenchurch Avenue, London, E.C., Merchant.
1906. Dunford, Jno. H., Trent Side Bone Works, Nottingham, Assistant Manager.
1912. Dunkesbühler, F. S., 63, Brook Street, Grosvenor Square, London, W., Technical Chemist.
1905. Dunlop, Harry, 231, St. Vincent Street, Glasgow, Chemist.
1892. Dunn, Fred, 193, Collins Street, Melbourne, Victoria, Australia, Analytical Chemist.
O.M. Dunn, Dr. J. T., 10, Dean Street, Newcastle-on-Tyne, Consulting Chemist.
O.M. Dunn, P., Northern Assurance Buildings, Albert Square, Manchester, Chemical Merchant.
1914. Dunn, Ralph J., The Manor House, King's Newnham, Rugby, Chemist.
1908. Dünschmann, Dr. Max, c/o Meister, Lucius, und Brüning, Ltd., Ellesmere Port, Cheshire, Manager.
1901. Dunsford, Geo., Laboratory, Wigan Coal and Iron Co., Ltd., Wigan, Analytical Chemist.
1907. Dunstan, A. E., Technical College, East Ham, E., Head of Chemical Department.
1907. Dupré, F. H., 2, Edinburgh Mansions, Howick Place, S.W., Analytical Chemist.
1907. Dupré, P. V., 2, Edinburgh Mansions, Howick Place, S.W., Analytical Chemist.
1905. Durfee, Winthrop C., 516, Atlantic Avenue, Boston, Mass., U.S.A., Manufacturing Chemist.
1897. Durkee, Frank W., Tuft's College, Medford, Mass., U.S.A., Professor of Chemistry.
1911. Durkin, Jos. A., c/o Butterworth Judson Co., Newark, N.J., U.S.A., Chemical Superintendent.
1907. Durrans, Thos. H., 10, Titchfield Terrace, Regent's Park, London, N.W., Chemist.
1891. Dvorkovitz, Dr P., 4, Broad Street Place, London, E.C., Technical Chemist.
1912. Dyche-Teague, F. C., 258, Gloucester Terrace, Hyde Park, London, W., Analytical Chemist and Bacteriologist.
O.M. Dyer, Dr. B., 17, Great Tower Street, London, E.C., Analytical and Consulting Chemist.
1907. Dyes, Dr. W. A.
1911. Dyke, F. Montague, Nelson Croft, Church Road, Bebington, Cheshire, Analytical Chemist.
O.M. Dyson, C. E., Flint, North Wales.
1902. Dyson, George W., 24, Clarkehouse Road, Sheffield, Analyst.
1892. Dyson, Septimus, Nyddcombe, Warlingham, Surrey, Manufacturing Chemist.

## E

1905. Eager, Chas. E., 77, Pearl Street, Boston, Mass., U.S.A., Merchant.
1904. Eames, Charles J., 99, Water Street, New York City, U.S.A., Consulting Chemist.
1910. Eardley, J. F., 265, Glossop Road, Sheffield, Pharmaceutical Chemist.
1913. Earl, J. C., c/o F. N. Faulding and Co., 54, King William Street, Adelaide, S. Australia, Chemist.

O.M. Earp, W. R., Preston Brook, near Warrington, Chemical Manufacturer.

1910. Easterfield, Prof. Thomas H., Victoria College, Wellington, New Zealand, Prof. of Chemistry.

1884. Eastick, C. E., 13, King Edward Street, Whitechapel, E., Sugar Refinery Director.

1909. Eastick, J. C. N., 49A, Clapton Common, London, N.E., Electrochemist.

O.M. Eastick, J. J., 2, St. Dunstan's Hill, London, E.C., Consulting Sugar Expert.

1890. Eastlake, A. W., Grosmont, Palace Road, Streatham Hill, S.W., Consulting Petroleum Engineer.

1909. Eastlake, William H., The Cable Shop, Northern Electric Co., Ltd., Montreal, Canada, Chemist.

1914. Easton, Reginald F., 76, North Street, Bedminster, Bristol, Technical Chemist.

1914. Eastwood, John A., "Horbury," Gordon Square, Marrickville, Sydney, N.S.W., Dyer.

1909. Eberlin, Leon W., 11, First Street, Rochester, N.Y., U.S.A., Chemist.

1892. Eddy, Harrison P., 14, Beacon Street, Boston, Mass., U.S.A., Superintendent.

1913. Edge, Alfred, Ravenhurst, Clayton Bridge, Manchester, Technical Chemist.

1885. Edge, Anthony, 79, West Milton Street, Readville, Mass., U.S.A., Chemist.

1909. Edge, J. Harold, "Great Marld," Smithills, Bolton, Lancashire, Technical Chemist.

1902. Edison, Thos. Alva, Edison Laboratory, Orange, N.J., U.S.A., Inventor and Manufacturer.

1908. Edmunds, Wm. T., 25, Church Road, Burry Port, South Wales, Assayer.

1911. Edwards, Alfred, The Laboratory, Meadow Lane Gas Works, Leeds, Analytical Chemist.

1909. Edwards, George M., 241, Pine Avenue West, Montreal, Canada, Paintworks Manager.

1915. Edwards, H. C., "Neotsbury," Laton Road, Hastings, Chemist.

1902. Edwards, H. Leaton, The Shanty, Banks Avenue, Meols, Hoylake, Cheshire, Analyst.

1895. Ehrenfeld, Prof. Chas. H., York Collegiate Institute, York, Pa., U.S.A., Professor of Chemistry.

1896. Ehrhardt, Ernest F., The Mersey Chemical Co., Bromborough Port, New Ferry, Cheshire, Research Chemist.

1910. Eilsberger, Dr. Ernst, Deutsche Solvaywerke, Bernburg (Anhalt), Germany, Director.

1913. Eipper, William R., 1594, Elbur Avenue, Lakewood, Ohio, U.S.A., Chemist.

1909. Eisenhart, M. H., c/o Eastman Kodak Co., Kodak Park, Rochester, N.Y., U.S.A., Chemist.

1901. Elkan, Leo A., Tannery, 1511, Webster Avenue, Chicago, Ill., U.S.A., Tanner.

1901. Elkins, Arthur W., 116, Prospect Street, East Orange, N.J., U.S.A., Civil Engineer.

1884. Elliott, Dr. A. H., College of Pharmacy, 115, West 68th Street, New York City, U.S.A., Consulting Engineer and Chemist.

1912. Elliott, Edward, c/o Reckitts (Over-Sea), Ltd., Burke Street, Redfern, N.S.W., Australia, Chemical Engineer.

1907. Elliott, George K., c/o Lunkenheimer Co., Cincinnati, Ohio, U.S.A., Chief Chemist.

1896. Elliott, Dr. J. F., O'Connell Street, Sydney, N.S.W., Manufacturing Chemist.

1902. Elliott, Victor G., Chemical Works, Rozelle, Sydney, N.S.W., Australia, Manufacturing Chemist.

1905. Ellis, Carleton, 143, Gates Avenue, Montclair, N.J., U.S.A., Chemical Engineer.

1893. Ellis, E. Victor, c/o J. McLellan, 25, York Place, Edinburgh, Analytical Chemist.

1894. Ellis, G. Beloe, 70, Chancery Lane, London, W.C., Patent Agent.

1913. Ellis, Henry D., 30, Blackheath Park, S.E., Metallurgical Engineer.

1912. Ellis, Percival W., 90, Tooley Street, London Bridge, S.E., Tanning Material Merchant.

1910. Ellis, Ridsdale, 723, Monadnock Building, Chicago, Ill., U.S.A., Patent Agent.

1910. Ellis, Rowland H., c/o Olympia Oil and Cake Co., Barlby Road, Selby, Yorks, Analytical Chemist.

1891. Ellison, Henry, Moor Lane House, Gomersal, near Leeds, Manufacturing Chemist.

O.M. Elmore, A. S., 72, Gloucester Terrace, Hyde Park, London, W., Electro-Metallurgist.

1907. Eladen, A. Vincent, 10, Gourock Road, Eltham, Kent, Analytical Chemist.

1911. Elsdon, Geo. D., Municipal Chemical Laboratory, 141, Regent Road, Salford, Manchester, Public Analyst.

1904. Elson, J. Hugh, Monroe Drug Co., Quincy, Ill., U.S.A., General Manager.

1909. Ely, Benjamin, The Limes, Pye Bridge, near Alfreton, Tar Distiller.

1910. Emannel, Louis V., 165, Rector Street, Perth Amboy, N.J., U.S.A., Metallurgical Engineer.

1910. Embley, Dr. E. H., 245, Latrobe Street, Melbourne, Victoria, Australia.

1902. Emery, Artbur L., c/o Smith, Emery, and Co., 651, Howard Street, San Francisco, Cal., U.S.A., Chemical Engineer.

1907. Emmons, Frank W., c/o Washburn Crosby Co., Minneapolis, Minn., U.S.A., Chemist.

1907. Emslie, B. Leslie, 1102-1105, Temple Building, Toronto, Canada, Agricultural Chemist.

1894. Enequist, John, 3710, Avenue J., Brooklyn, N.Y., U.S.A., Chemical Engineer.

1904. Englehard, Charles, 30, Church Street, New York City, U.S.A., Platinum Importer.

1895. English, Frank H., 89, Belgrave Road, Wanstead, N.E., Analytical Chemist.

1906. Ephraim, Dr. Julius, II, Königgraetzerstrasse 69, Berlin, S.W., Germany, Chemist and Patent Agent.

1911. Epps, James W., Holland Street, London, S.E., Chemist.

1909. Epstein, Harry M., 175, Front Street, New York City, U.S.A., Works Manager.

1914. Erbslöb, S. H., Hafen 29, Düsseldorf, Germany, Engineering Chemist.

1907. Erdoes, Julius, 1100, Brook Avenue, New York City, U.S.A., Chemical Engineer.

1902. Erhart, Wm. H., 81, Maiden Lane, New York City, U.S.A., Manufacturing Chemist.

1904. Ermen, Walter F. A., The Cranbery, Juiz de Fora, Minas Geraes, Brazil, Analytical Chemist.

1888. Erskine, J. K., P.O. Box 88, Benoni, Transvaal, Analytical Chemist.

1897. Escher, Paul, c/o Swift and Co., Chemical Laboratory, Union Stock Yards, Chicago, Ill., U.S.A., Chemist.

1884. Esilman, A., 38, Norwood Avenue, Southport, Lancashire, Analytical Chemist.

1913. Esling, Fred., c/o Burmah Oil Co., Ltd., Gresham House, Old Broad Street, London, E.C., Chemical Engineer.

1912. Espenhahn, E. V., c/o Metropolitan Gas Co., 186, Flinders Street, Melbourne, Victoria, Australia, Works Chemist.

O.M. Estcourt, C., 5, Seymour Grove, Old Trafford, Manchester, Consulting Chemist.

1903. Euler, C. G., 18–20, Platt Street, New York City, U.S.A., Chemical Agent.

1912. Evans, Edward V., South Metropolitan Gas Co., Old Kent Road, London, S.E., Chief Chemist.

1883. Evans, Enoch, 660, Coventry Road, Birmingham, Accountant.

1903. Evans, F. Sparke, Avonside Tannery, Bristol, Tanner.

1905. Evans, Geo. A., 832, Yonge Street, Toronto, Canada, Pharmacist.

1913. Evans, George A., c/o Australian Explosives and Chemical Co., Ltd., 135, William Street, Melbourne, Victoria, Australia, General Manager.

1905. Evans, John, 67, Surrey Street, Sheffield, Analytical Chemist.

1908. Evans, Prof. Nevil Norton, Redpath Library, McGill University, Montreal, Canada, Associate Professor of Chemistry.

1912. Evans, Sam, 4, Whickham Avenue, Dunston-on-Tyne, Chemist.
1912. Evans, Ulick R., 28, Victoria Street, Westminster, S.W., Consulting Electrochemist.
1898. Evans, Wm. Perceval, Canterbury College, Christchurch, New Zealand, Professor of Chemistry.
1909. Everette, Dr. W. E., 3512, South 11th Street, Tacoma, Wash., U.S.A., Consulting Chemical Engineer.
1904. Everitt, Walter, Norwood Wharf, Southall, Middlesex, Analyst.
1912. Evers, Norman, c/o Allen and Hanbury's, Ltd., Bethnal Green, London, E., Analytical Chemist.
1907. Eves, Archie, P., 762, East Buchtel Avenue, Akron, Ohio, U.S.A., Chemist.
1894. Ewan, Dr. Thos., c/o Cassel Cyanide Co., Shuna Street, Maryhill, Glasgow, Chemist.
1905. Eynon, Lewis, 4, Stag Lane, Buckhurst Hill, Essex, Chief Chemist (London Beetroot Sugar Association).

## F

1898. Fadé, Louis, c/o Dr. F. Stockhausen, Weissfrauenstrasse 7-9, Frankfort a/M., Germany, Chemist and Director.
1902. Faill, Jas., 52, Robertson Street, Glasgow, Technical Chemist.
1902. Fairchild, Benj. T., P.O. Box 1120, New York City, U.S.A., Manufacturing Chemist.
1911. Fairchild, B. Tappen, 74, Laight Street, New York City, U.S.A., Analytical Chemist.
1910. Fairclough, Lt.-Col. Brereton, Quarry House, Hill Cliffe, Warrington, Cheshire, Miller.
1911. Fairfield, Thos. J., c/o W. T. Glover and Co., Trafford Park, Manchester, Analytical Chemist.
1903. Fairhall, E. J., Lindfield, Windmill Lane, Southall, Middlesex, Chemist.
O.M. Fairley, T., 17, East Parade, Leeds, Analytical Chemist.
1901. Fairlie, Jas., Camelon Chemical Works, Falkirk, Manufacturing Chemist.
1911. Farey, F. O., 905, McGill Building, Montreal, P.Q., Canada, Chemist.
1910. Farr, Harry, Free Library, Cardiff, Librarian.
O.M. Farrant, N., c/o J. Nickolson and Sons, Ltd., Chemical Works, Hunslet, Leeds, Chemist.
1913. Farrar, Stanley C., c/o John Wright and Co., Essex Works, Aston, Birmingham, Chemical Technologist.
1897. Farrell, Frank J., Shanrahan, Beccles, Suffolk, Artificial Silk Manufacturer.
O.M. Farrington, T., 4, Waterloo Place, Cork, Ireland, Chemical Engineer.
1913. Farrow, F. D., Rhodes University College, Grahamstown, South Africa, Lecturer in Chemistry.
1909. Fath, Dr. Arthur, Chemical Engineer.
1903. Fawsitt, Prof. Chas. E., The University, Sydney, N.S.W., Australia, Prof. of Chemistry.
1914. Fearnley, C. A., 1, Alcester Terrace, Shepherd's Lane, Leeds, Technical Chemist.
1903. Feilmann, Dr. M. E., c/o Osram Lamp Works, Ltd., Brook Green, Hammersmith, W., Chemist.
1913. Feldenheimer, Wm., 20, Holborn Viaduct, London, E.C., Clay Merchant.
1914. Fell, Henry, Londesborough Hotel, Selby, Yorks, Chemist.
1909 Fell, Wm. M. W., 27, Clarendon Road, Garston, Liverpool, Chemist.
1905. Felton, Herbert L., 516, East Second Street, South Boston, Mass., U.S.A., Distiller.
1900. Ferguson, Prof. Geo. A., 121, West 42nd Street, New York City, U.S.A., Professor of Analytical Chemistry.
1914. Ferguson, Jas., Luton Road, Harpenden, Herts, Technical Chemist.
O.M. Ferguson, Prof. J., The University, Glasgow, Professor of Chemistry.
1902. Fergusson, Donald M., c/o Acadia Sugar Refining Co., Halifax, N.S., Canada, Analytical Chemist.
1883. Fergusson, H., Prince Regent's Wharf, Victoria Docks, E., Technical Chemist.
1893. Fiebing, John H., 233, Reed Street, Milwaukee, Wis., U.S.A., Leather Trade Chemist.
1911. Field, Allan J., c/o G. Siegle Co., Rosebank, Staten Island, N.Y., U.S.A., Chemist.
1885. Field, E. W., Brewer.
1887. Field, S. S., 3, Glenlnce Road, Blackheath, S.E., Manufacturing Chemist.
1891. Field, Wm. Eddington, Martin Street, Elsternwick, Melbourne, Victoria, Chemist.
1900. Fillis, Frank, 106, London Road, Neath, South Wales, Cement Works Manager.
1907. Finch, Archibald M., Vitriol and Chemical Works, Cattedown, Plymouth, Chemical Manufacturer.
1910. Findlater, James, c/o Price's Patent Candle Co., Ltd., Bromborough Pool, near Birkenhead, Chief Chemist.
1910. Findley, Albert E., Dept. of Applied Science, The University, St. George's Square, Sheffield, Lecturer.
1899. Fingland, Jno. J., Kaslo, B.C., Canada, Analytical Chemist.
1911. Fink, F. W., 420, Riverside Drive, New York City, U.S.A., Manufacturing Chemist.
1904. Finn, Cornelius P., Hemsworth Colliery, near Wakefield, Yorks, Coke Ovens Manager.
1903. Fischer, Dr. Carl, 213-215, Water Street, New York City, U.S.A., Chemist.
1903. Fish, Chas. C. R., 439, Boylston Street, Boston, Mass., U.S.A., Chemist.
1911. Fish, Charles W., Rose Hill, Rawcliffe Bridge, S.O., Yorks, Chemist and Paper Technologist.
1900. Fisher, Henry, 16, East 96th Street, New York City, U.S.A., Teacher of Chemistry.
1915. Fisher, L. E., The Laboratory, Messrs. Ardol, Ltd., Barlby Road, Selby, Yorks, Works Chemist.
1895. Fison, Jno., Messrs. Jas. Fison and Sons, Thetford, Norfolk, Chemical Manufacturer.
1904. Fitch, A. J., 67, Branstone Road, Burton-on-Trent, Brewer's Chemist.
1900. Fitz-Randolph, R.B., State Laboratory of Hygiene, Trenton, N.J., U.S.A., Bacteriologist and Chemist.
1896. Flammer, E., c/o Kraemer und Flammer, Heilbronn a/N., Wurttemburg, Germany, Manufacturing Chemist.
1913. Fleming, M. D., 26, Aytoun Road, Pollokshields, Glasgow, Analyst.
1893. Fletcher, E. Morley, 30, Grosvenor Place, Newcastle-on-Tyne, Alkali Works Inspector.
O.M. Fletcher, F. W., c/o Fletcher, Fletcher, and Co., Ltd., Holloway, N., Manufacturing Chemist.
1891. Fletcher, R. Jaques, North Geelong, Victoria, Manufacturing Chemist.
1904. Fletcher, Wm. E., 411, West Broad Street, Tamaqua, Pa., U.S.A., Chemist.
1912. Flürscheim, Dr. Bernhard J., Rushmoor, Fleet, Hampshire, Research Chemist.
1899. Focht, Louis, 12, Atterbury Avenue, Trenton, N.J., U.S.A., Civil Engineer.
1890. Foden, Alfred, 19, Lancaster Avenue, Sefton Park, Liverpool, Metallurgical Chemist.
1900. Foersterling, Dr. H., c/o Roessler Hasslacher Chem. Co., Perth Amboy, N.J., U.S.A., Chemist.
1895. Forbes, Paul R., c/o Geo. I. Watson, 86, Cannon Street, London, E.C., Chemist and Assayer.
1911. Ford, Edward J., 36, Rue Vandermaelen, Molenbeck St. Jean, Brussels, Chemist.
1893. Ford, J. B., jun., Michigan Alkali Co., Wyandotte, Mich., U.S.A., Secretary and Treasurer.
1889. Ford, Jno. S., Abbey Brewery, Edinburgh, Analyst.
1914. Ford, Joseph James, c/o Skinner and Holdford, Ltd., Waleswood Collieries, Waleswood, near Sheffield, Analytical Chemist.
1885. Formoy, J. Arthur, Fairlight, Limpsfield, Surrey, (Jnls.) 16, Pulteney Street, Bath, Oil Expert.

1904 Forrest, Chas. N., Maurer, N.J., U.S.A., Chemist.
1898. Forrest, J. Kerr, Brae Lea, Austen Road, Guildford, Surrey, Manufacturing Chemist.
1890. Forrester, A. M., c/o Richmond Guano Co., Richmond, Va., U.S.A., Analytical Chemist.
1905. Forrester, H. A., Fabrica do Gaz, Recife, Pernambuco, Brazil, Chemical Works Manager.
1909. Forshaw, Arthur, c/o John Wright and Co., Ltd., Essex Works, Aston, Birmingham, Works Chemist.
1902. Forstall, Alf. E., 84, William Street, New York City, U.S.A., Consulting Gas Engineer.
1902. Forster, Ferdinand E. P., c/o Messrs. Bass and Co., 19, Guild Street, and (Jnls.) The River House, Burton-on-Trent, Brewer's Chemist.
1907. Forster, Francis, c/o Champion, Druce, and Co., Ltd., 6, Laurence Pountney Hill, London, E.C., Lead Manufacturer.
1899. Forster, Dr. M. O., F.R.S., 84, Cornwall Gardens, South Kensington, S.W., Chemist.
1884. Forster, Sir Ralph C., Bart., c/o Messrs. Bessler, Waechter, and Co., Salisbury House, Finshury Circus, London, E.C., Chemical Merchant.
1915. Forster, Dr. R. B., University College, Galway, Ireland, Chemist.
1884. Forth, Henry, Stoke Lacy, Marple, Cheshire, Drysalter.
1907. Forward, Charles C., Dept. of Inland Revenue Lahy., 50, Bedford Road, Halifax, N.S., Canada, Chemist.
1906. Foster, Roht. K., Church Street, Middle Brighton, Melbourne, Victoria, Pharmaceutical Chemist.
O.M. Foster, R. Le Neve, Fulshaw Cottage, Wilmslow, Cheshire, Manufacturing Chemist.
1888. Foster, Wm., St. Martin's Terrace, Newton Park, Leeds, Manufacturing Chemist.
1906. Foucar, J. Louis, 15, Morden Road, Blackheath, S.E., Chemist.
1891. Fowler, Dr. Gilbert J., Frankland Laboratory, Chem. Dept., Victoria University, Manchester, (Manchester Corporation Rivers Committee).
1896. Fox, A. Stanley, Uplees, Faversham, Kent, Explosives Works Manager.
1912. Fox, Charles P., 395, Doyle Street. Akron, Ohio, U.S.A., Chemist.
1913. Fox, Edward Carey, 27, Scarth Road, Toronto, Canada, Pork Packer.
1898. Fox, Jno., Varuna, Grappenhall, Cheshire, Analyst.
1911. Fox, Dr. John J., 6, Alkham Road, Stamford Hill, N., Government Analyst.
O.M. Fox, T., jun., c/o Fox Bros. and Co., Ltd., Wellington, Somerset, Wool Manufacturer.
1905. France, Edward W., Philadelphia Textile School. Broad and Pine Streets, Philadelphia, Pa., U.S.A., Director.
O.M. Francis, E. G., 29, Matheson Road, West Kensington, W., and (Jnls.) c/o T. Fitzgibbon, 115, Harbour Street, Fulham Palace Road, S.W., Glucose Works Manager.
O.M. Francis, G. Bult, The British Drug Houses, Ltd., 22–30, Graham Street, City Road, London, N., Wholesale Druggist.
O.M. Francis, W. H., 11, Bramham Gardens, South Kensington, London, S.W., Wholesale Druggist.
1906. Frank, Prof. Dr. A., Bismarckstrasse 10, Charlottenburg, Germany, Chemist.
1908. Frank, Dr. Fritz, Lützowstrasse 96, Berlin, W., 68, Germany, Public Analyst.
1894. Frank, Jerome W., 29, Broadway, New York City, U.S.A., Chemist.
1886. Frankenburg, Isidor, Greengate Rubber Works, Salford, Manchester, Indiarubber Manufacturer.
1912. Frankenhurg, Sydney, Hefferston Grange, Weaverham, Cheshire, Indiarubber Manufacturer.
1895. Frankforter, Dr. G. B., University of Minnesota, Minneapolis, Minn., U.S.A., Prof. of Chemistry.
1904. Frankl, A., Clothilde Chemical Works, Nagy Bocskó, Hungary, Manager.
O.M. Frankland, H., Streonshalh, The Crescent, Linthorpe, Middlesbrough, Analytical Chemist.
O.M. Frankland, Prof. P. F., F.R.S., The University, Edgbaston, Birmingham, Professor of Chemistry.
1901. Frasch, Hans A., 52, Broadway, New York City, U.S.A., Manager
1910. Fraser, Arthur, Casilla 1464, Valparaiso, Chile, Analyst.
1891. Fraser, L. McG., Engineering Works, Dagenham, Essex, Chemical Engineer.
1902. Frederick, Geo. E., jun., P.O. Box 762, New York, City, U.S.A., Chemical Merchant.
1900. French, Thos., 806, Stanley Street, Nelson; B.C., Canada, Chemist.
1911. French, Wm., Wheatfield, Dallas Road, Lancaster, Manager.
1903. Frerichs, Dr. F. W., 4320, Washington Boulevard, St. Louis, Mo., U.S.A., Manufacturing Chemist.
1913. Frew, John, Box I, Johanneshurg, South Africa, Chemist.
1907. Freytag, Henry, c/o O. Isler and Co., 35, Dickinson Street, Manchester, Chemical Merchant.
1886. Fries, Dr. Harold H., 92, Reade Street, New York City, U.S.A., Chemical Manufacturer.
1899. Fritzsche, Karl, c/o Schimmel und Co., Miltitz, near Leipzig, Germany, Manufacturer of Essential Oils.
1915. Frost, Charles E., 259, Metcalfe Avenue, Westmount, P.O., Canada, Manufacturing Chemist.
1884. Frost, Joe, Rocky Mount, Somerset Road, Huddersfield, Manufacturing Chemist.
O.M. Fryer, Dr. A. C., 13, Eaton Crescent, Clifton, Bristol, Alkali Works Inspector.
1904. Fryer, P. J., The Firs, Nettlestead Green, Kent, Analyst.
1889. Fuerst, Jos. F., 17, Philpot Lane, London, E.C., Chemical and Oil Merchant.
1895. Fuerst, W. F., 87, Nassau Street, New York City, U.S.A., Chemical Merchant.
1913. Fulks, Elbridge B., American Tar Products Co., 208, South La Salle Street, Chicago, Ill., U.S.A., Vice-President.
1894. Fuller, Chas. J. P., 603, Chorley New Road, Horwich, near Bolton, Analytical Chemist.
1914. Fuller, Cyril D., Aspinall's Enamel, Ltd., New Cross, S.E., Works Manager.
1902. Fuller, Henry C., Institute of Industrial Research, Washington, D.C., U.S.A., Analytical Chemist.
O.M. Fuller, Wm., Vanbrugh Cottage, Maze Hill, S.E., Chemist.
1898. Fulmer, Elton, Pullman, Wash., U.S.A., Professor of Chemistry.
1909. Fulweiler, W. H., 1706, North Broad Street, Philadelphia, Pa., U.S.A., Engineer.
1885. Fyfe, Jno., 7, West George Street, Glasgow, Oil Works Director.

## G

1915. Gahy, F. A., Hydro-Electric Power Commission of Ontario, 709, Continental Life Building, Toronto, Canada, Chief Engineer.
1909. Gaede, Chas. W., c/o National Silk Dyeing Co., Williamsport, Pa., U.S.A., Silk Dyer.
1913. Gage, Roscoe M., The Oaks, Springfield, Mass., U.S.A., Chemical Engineer.
1906. Gagnehin, Chas. L., 140, Oliver Street, Boston, Mass., U.S.A., Dyestuff Merchant.
1907. Gaines, Richard H., 147, Varick Street, New York City, U.S.A., Chemist (Board of Water Supply).
1904. Gair, C. J. Dickenson, 39, Cranston Road, Forest Hill, S.E., Analytical Chemist.
1912. Gajjar, M. J., Techno-chemical Laboratory, Girgaum, Bombay, India, Consulting Chemist.
1912. Gale, Corpl. R. C., 38, Scarsdale Villas, Kensington, W., and (Jnls.) London Electrical Engineers, Drake's Island, Plymouth, Technical Chemist.
1884. Gall, Henry, 2, Rue Blanche, Paris, France, Technical Chemist.

1905. Gall, J. B., c/o Callender's Cable and Construction Co., Belvedere, Kent, Chemist.
1911. Gallagher, Jas. L., o/o Lever Bros., Ltd., Sydney, N.S.W., Australia, Chemist.
1897. Galletly, J. C., o/o Newlands and Warner, 135, St. Vincent Street, Glasgow, Rubber Chemist.
1901. Gallivan, Dr. Frank B., 113, Third Street, South Boston, Mass., U.S.A., Chemist.
1903. Gallum, Albert F., 1000, North Water Street, Milwaukee, Wis., U.S.A., Tanner.
1901. Gallup, W. Arthur, Arnold Printworks, North Adams, Mass., U.S.A., Printer.
1901. Galpin, Harry T., 57, West 57th Street, New York City, U.S.A., Chemist.
1891. Galt, Hugh Allen, Columbia Chemical Co., Barberton, Ohio, U.S.A., Works Manager.
1894. Gane, Eustace H., 91, Fulton Street, New York City, U.S.A., Pharmaceutical Chemist.
1901. Gansser, Dr. A., c/o Messrs. Lepetit, Dollfus, & Gansser, Garessio-Ponte (Provincia di Cuneo), Italy, Chemical Engineer.
1911. Garhntt, C. Durham, 43, Island Road, Garston, Liverpool, Analytical Chemist.
1896. Gardéir, Aimé 51, Rue St. Ferréol, Marseilles, France. Director of Chemical Co.
1910. Gardner, Arthur L., 233, Water Street, Perth Amboy, N.J., U.S.A., Chemical Engineer.
1907. Gardner, Edward, The Tryst, Bigwood Road, Meadway, Hendon, N.W., Metallurgical Chemist.
1909. Gardner, Henry A., 19th and B. Streets N.W., Washington, D.C., U.S.A., Chemist.
1913. Gardner, Henry D., jun., 11, Glenmore Road, Belsize Park, London, N.W., Technical Chemist.
1891. Gardner, Prof. Walter M., Technical College, Bradford, Director of Chemical and Dyeing Departments.
1897. Garfield, Jos., Thackley, Bradford, Yorks, Civil Engineer.
1888. Garibaldi, Joachim A., 21, Church Place, Gibraltar, Chemist.
1910. Garland, Charles S., 57, Garratt Lane, Wandsworth, S.W., Chemist and Works Manager.
1911. Garner, John H., Sewage Works, Deighton, Huddersfield, Chemist.
1890. Garrett, Ccl. Dr. F. C., Armstrong College, Newcastle-on-Tyne, Teacher of Science.
1906. Garroway, Major John, 58, Buchanan Street, Glasgow, Chemist.
1908. Garson, Jas. W., Lancaster Court Hotel, Lancaster Gate, London, W., Managing Director, Lewis Berger and Sons, Ltd.
O.M. Garton, Sir Richard, Messrs. Hill, Garton, and Co., Southampton Wharf, Battersea, S.W., Glucose Manufacturer.
1886. Gascoyne, Dr. W. J., 27, South Gay Street, Baltimore, Md., U.S.A., Analytical Chemist.
O.M. Gaskell, Holbrook, Erindale, Frodsham, Cheshire, Alkali Manufacturer.
1902. Gaskell, Holbrook, jun., Hillcroft, Church Road, Woolton, near Liverpool, Engineer.
1915. Gatecliff, John, 32, Delph Lane, Leeds, Works Chemist.
1908. Gatehouse, Frank B., "Maristowe," Butts Green Road, Hornchurch, Essex, Chemist and Technical Journalist.
1912. Gates, Alfred E., c/o Messrs. T. Lye and Sons, Luton, Beds, Works Chemist.
O.M. Gatheral, Geo., Beechwood, Sherbourne Road, Acocks Green, near Birmingham.
1906. Gaunt, Percy, Macclesfield Corporation Sewage Works, Prestbury, near Macclesfield, Chemist.
1912. Gee, Wm. J., 48, Kingsmead Road, Tulse Hill, London, S.W., Chemical Engineer.
1891. Geisler, Dr. Jos. F., New York Mercantile Exchange Building, 6, Harrison Street, New York City, U.S.A., Consulting Chemist.
1901. Gemmell, G. H., 4, Lindsay Place, George IV Bridge, Edinburgh, Analytical Chemist.
1907. Gemmell, Wm., 3, East Parade, Newcastle-on-Tyne, Analytical Chemist.
1901. Gent, Percy W., Trentholme, Misterton, near Gainsboro', Chemist.
1897. Gent, Wm. T., Springfield, Misterton, near Gainsboro', Metallurgical Chemist.
1913. Gepp, Herbert W., c/o Amalgamated Zinc (De Bavay's), Ltd., Broken Hill, N.S.W., Australia, General Manager.
1906. Gerkensmeyer, Henry H., 207, Mississippi Avenue, Joliet, Ill., U.S.A., Chemist.
O.M. Gerland, Dr. B. W., 105, Plantation Street, Accrington, Consulting Chemist.
1912. Ghislain, Raoul, 18, Rue du Mont de Piété, Mons, Belgium, Chemical Engineer.
1908. Gianoli, Prof. Giuseppe, Via Porlezza 2, Milano, Italy, Chemical Engineer and Editor (L'Industria).
1912. Gibb, W. Doig, South Metropolitan Gas Co., 709, Old Kent Road, London, S.E., Chief Engineer.
1911. Gibbings, W. Alan, P.O. Box Sannomiya 174, Kobe, Japan, Works Manager and Chemist.
1903. Gibbings, Wm., Woodside, Halebank, Widnes, Works Manager.
1910. Gibbins, Roland B., 18, Wheeley's Lane, Birmingham, Chemical Manufacturer.
1902. Gibbon, Edw., Belvedere, Park Road, Clydach, R.S.O., Glam., Works Chemist.
1915. Gibbon, John, The British Explosives Syndicate, Ltd., Factory, Pitsey, Essex, Chemist.
1904. Gibbs, A. E., c/o Pennsylvania Salt Manufacturing Co., Greenwich Point, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1913. Gibbs, Victor G., c/o Wm. Pearson, Ltd., Clough Road, Hull, Works Manager.
O.M. Gibbs, Wm. P., The Sulphite Pulp Mills, Hjerpen, Sweden, Analytical Chemist.
O.M. Gibson, J. M., o/o Buckley Brick and Tile Co., Buckley, *viâ* Chester, Brick and Tile Manufacturer.
1905. Gibson, John, 360-366, Collins Street, Melbourne, Vic., Australia, Concrete Manufactnrer.
1913. Gibson, R. M., 58, Chester Road, Buckley, *viâ* Chester, Clay Goods Manufacturer.
1913. Gibson, Stanton, 28, Lordship Park, Stoke Newington, N., Factory Chemist.
1905. Gibson, Wm. F., 72, Woodstock Avenue, Golders Green, N.W., Works Chemist.
1914. Gidden, W. T., Woodside, Abbey Road, Smethwick, near Birmingham, Technical Chemist.
1899. Gifford, Wm. E., c/o Baker and Co., 408, New Jersey Railroad Avenue, Newark, N.J., U.S.A., Chemist.
1892. Gilbard, J. Francis H., 245, Dalston Lane, Hackney, N.E., Analytical Chemist.
1905. Gilbertson, Isaac H., 33, Broad Street, Rhodes, near Middleton, Lancs, Calico Printer.
1903. Gilby, Joseph W., 58, Beeches Road, West Bromwich, Staffs, Works Chemist.
O.M. Gilchrist, Percy Carlyle, F.R.S., A.R.S.M., M.Inst.C.E. & M.E., Reform Club, Pall Mall, London, S.W., Metallurgist.
1884. Gilchrist, Peter S., Charlotte, N.C., U.S.A., Chemical Engineer.
1900. Gildersleeve, W. H., Johnson City, Tenn., U.S.A., Chemist.
O.M. Giles, W. B., The Grange, Leyton, Essex, Chemical Manufacturer.
1886. Gill, Dr. Ang. H., Massachusetts Institute of Technology, Boston, Mass., U.S.A., Professor of Technical Analysis.
1913. Gill, Harold W., South African School of Mines and Technology, Johannesburg, South Africa, Lecturer on Chemistry.
1915. Gill, Hubert A., 55-56, Chancery Lane, London, W.C., Chartered Patent Agent.
1909. Gill, John H., 16, Premier Road, Gregory Boulevard, Nottingham, Soapworks Chemist.
1901. Gill, Wm. S., c/o Farquhar and Gill, North of Scotland Colour Works, Aberdeen, Colour and Varnish Manufacturer.
1901. Gilles, Wm. S., The Cottage, Bocking, near Braintree, Essex, Technical Chemist.
1888. Gillman, Gustave, Ferrocarril de Murcia á Granada, Aguilas, Prov. de Murcia, Spain, Civil Engineer.

1891. Gimingham, Edw. A., Croyland, Clapton Common, N., Technical Electrician.
1886. Girdwood, Dr. G. P., 615, University Street, Montreal, Canada, Professor of Chemistry.
1906. Girtin, Thomas, H. L. Raphael's Refinery, 48, Thomas Street, Burdett Road, London, E., Bullion Refiner.
1903. Gladding, Thos. S., 181, Front Street, New York City, U.S.A., Analytical Chemist.
1886. Glaeser, F. A., Carpenters' Road, Stratford, E., Varnish Manufacturer.
1906. Glass, A. Melville, "Copley Dene," Park Avenue, Hampstead, N.W., Patent Agent.
1901. Glegg, Robt., Agricultural Laboratory, Marischal College, Aberdeen, Analytical Chemist.
1894. Glen, Chas., Glengowan Printworks, Caldercruix, Scotland, Calico Printer.
1884. Glendinning, H., Winnington House, Northwich, Cheshire, Technical Chemist.
1888. Gloag, Robt. F., Lothian Road, Middlesbrough, Secretary.
1912. Gloag, Vivian F., Millbury House, Darlington Road, Ferryhill, Co. Durham, Chemical Works Manager.
1896. Glover, H., 6445, Emlen Street, Germantown, Philadelphia, Pa., U.S.A., Chemical Works Superintendent.
O.M. Glover, William, Albareda 27, Seville, Spain, Technical Chemist.
1911. Gmach, Ludwig T., Kew Bridge Label Works, Waldeck Road, Chiswick, W., Manufacturer.
1911. Goetchius, John M., c/o General Chemical Co., 25, Broad Street, New York City, U.S.A., Sales Manager.
1915. Golding, Geo., "Haverthwaite," Litherland Park, Liverpool, Analytical Chemist.
1898. Golding, Jno., University College, Reading, Agricultural Chemist.
1906. Goldschmidt, Dr. Karl, Chemical Works, Essen-Ruhr, Germany, Manufacturing Chemist.
O.M. Goldschmidt, Dr. S. A., 11, Broadway, New York City, U.S.A., President (Columbia Chemical Works).
1897. Goldschmiedt, Dr. Guido, Wasagasse 9, Wien IX, Austria, Professor of Chemistry, University of Vienna.
1895. Goldsmith, Byron B., 19, East 74th Street, New York City, U.S.A., Vice-President (American Lead Pencil Co.).
1899. Goldsmith, Dr. Jno. N., 67, Chancery Lane, London, W.C., Chemist.
1914. Goldsmith, L. D., 31, Colvestone Crescent, West Hackney, N.E., Research Chemist.
1906. Goodall, Wm. Leslie, Finboro' Road, Stowmarket, Suffolk, Works Chemist.
1909. Goodban, Leonard, 43, Addison Gardens, Kensington, London, W., Works Chemist.
1912. Gooderham, J. Leys, 49, Wellington Street East, Toronto, Canada, Chemist.
1904. Gooding, E. Clande, Willow House, Washford, Somerset, Chemist.
1913. Goodman, Alexander, c/o Lever Bros., Ltd., Sun light Wharf, Upper Thames Street, London, E.C., Manager.
1915. Goodman, V. E., c/o Waterlow and Sons, Ltd., 68-70, Worship Street, Finsbury, E.C., Manager of Cheque Department.
1898. Goodrich, Chas. C., 60, Broadway, New York City, U.S.A., Rubber Manufacturer.
1884. Goodwin, C. C., Racefield, St. Margaret's Road, Altrincham, Cheshire, Soapmaker.
1913. Goodwin, H. W., c/o Charles Case and Sons, Westbury, Wilts, Analytical Chemist.
1894. Goodwin, Dr. W. L., Library Dept., Gordon Hall, School of Mining, Kingston, Canada, Professor of Chemistry.
O.M. Goppelsroeder, Prof. Dr. F., Leimenstrasse 51, Basel, Switzerland, Professor of Chemistry.
1884. Gordon, J. G., Queen Anne's Mansions, Westminster. S W., Steel Manufacturer.
1904. Gotthelf, August H., Hastings-on-Hudson, N.Y., U.S.A., Chemist.
1914. Gotts, H. S., Corrisson Works, Carnwarth Road, Fulham, S.W., Sugar Manufacturers.
1890. Goulding, Sir Wm. J., Bart., c/o W. and H. M. Goulding, Ltd., Alexandra Road, East Wall, Dublin, Manure Manufacturer.
O.M. Gowland, Prof. W., F.R.S., 13, Russell Road, Kensington, W., Professor of Metallurgy (Royal School of Mines).
1886. Goyder, G. A., 110, Gawler Place, Adelaide, Sonth Australia, Chemist and Assayer.
1890. Grabfield, Dr. J. P., c/o Morris and Co., Chemical Laboratory, Union Stock Yards, Chicago, Ill., U.S.A., Chemist.
1906. Graesser, Norman H., Argoed Hall, Llangollen, N. Wales, Manufacturing Chemist.
O.M. Graham, C. C., Oriel House, Scarborough, Yorks. Technical Chemist.
1913. Graham, Jos. I., Chemist.
1883. Grandage, H., c/o S. Smethurst and Sons, Woolfold Dye and Bleach Works, Bury, Lancashire, Dyer.
1914. Grandel, Paulin, Managing Director.
1897. Granger, Dr. J. Darnell, 57, Holmwood Street, Newtown, Sydney, N.S.W., Australia, Analytical Chemist.
1905. Grant, Alexander, 15, Hermitage Drive, Edinburgh, Baker.
1896. Graves, Geo. H., 219, West 81st Street, New York City, U.S.A., Manufacturing Chemist.
1896. Graves, Walter G., 1950, East 90th Street, Cleveland, Ohio, U.S.A., Chemist.
1914. Gray, George, 3, Victoria Drive, Rock Ferry, Cheshire, Technical Chemist.
1884. Gray, G. Watson, 8, Inner Temple, Dale Street, Liverpool, Consulting Chemist and Assayer.
1911. Gray, Dr. G. W., c/o The Texas Co., Houston, Texas, U.S.A., Chairman, Manufacturing Committee.
1910. Gray, H. Le Breton, c/o Eastman Kodak Co., Rochester, N.Y., U.S.A., Superintendent, Film Department.
1904. Gray, Jas., P.O. Box 5254, Johannesburg, Transvaal, Chemist.
1901. Gray, J. Campbell, The Cottage, Strines, near Stockport, Printworks Chemist.
1886. Gray, Jno., 3, Victoria Drive, Rock Ferry, near Birkenhead, Technical Chemist.
1896. Gray, Prof. Thos., Royal Technical College, Glasgow, Professor of Technical Chemistry.
1905. Gray, W. B., Messrs. Lever Bros., Durban, Natal, South Africa, Analytical Chemist.
1903. Gray, Wm. S., 76, William Street, New York City, U.S.A., Chemical Merchant.
1908. Gray, Wm. T., Port-Credit, Ontario, Canada, Starch Manufacturer.
1909. Greeff, R. H., Thames House, Queen Street Place, London, E.C., and (Jnls.) "Arima," Denbridge Road, Bickley, Kent, Chemical Merchant.
1894. Greeff, R. W., Thames House, Queen Street Place, London, E.C., and (Jnls.) Elm Bank, Bromley, Kent, Chemical Merchant.
O.M. Green, Prof. Arthur G., 49, Cardigan Road, Headingley, and The University, Leeds, Professor of Tinctorial Chemistry.
1907. Green, Clarence, c/o Nicholson's Raincoat Co., Beaumont Works, St. Albans, Herts, Chemist.
1906. Green, Ernest, 98, Cheadle Road, Cheadle Hulme, Cheshire, Science Teacher.
O.M. Green, H., Hayle Mill, Maidstone, Paper Manufacturer.
O.M. Green, L., Lower Tovil, Maidstone, Paper Manufacturer.
1915. Green, William, 206, Peel Mount, Burnley Road, Accrington, Lancs, Pottery Manager.
1908. Green, Dr. W. Heber, Chemical Laboratory, The University, Melbourne, Victoria, Lecturer in Chemistry.
O.M. Greensway, A. J., The Orchard, Chertsey, Surrey, Sub-Editor of Chemical Society's Journal.
1914. Greene, S. G., 10, Carlton Road, Sidcup, Kent. Analytical Chemist.
1909. Greenhough, George D., 21, Mincing Lane, London, E.C., Chemical Broker.

1913. Greenough, Thomas R., Beechwood, Leigh, Lancashire, Analytical Chemist.
1902. Greenwood, Conrad V., Noyna, Dowhills Road, Blundellsands, Liverpool, Cotton Mill Manager.
1907. Greenwood, Herbert W., c/o The Boundary Chemical Co., Ltd., Cranmer Street, Liverpool, Metallurgical Chemist.
O.M. Greenwood, Holmes, Regent House, Hartmann Street, Accrington, Technical Chemist.
1897. Gref, Anthony, 117, Hudson Street, New York City, U.S.A., Patent Lawyer.
1909. Gregory, Cecil H., The Morgan Crucible Co., Battersea, London, S.W., Crucible Manufacturer.
1907. Gregory, Joshua C., 128, Wellington Street, Glasgow, Analytical and Consulting Chemist.
1912. Gresham, Harold E., County Laboratories, 36, Dansie Street. Liverpool, Analytical Chemist.
1915. Greville, Henry, 30, Empress Road, Liscard, Cheshire, Research Chemist.
1890. Griffin, Jno. R., Kemble Street, Kingsway, London, W.C., Chemical Apparatus Maker.
1886. Griffin, Martin L., c/o Oxford Paper Co., Rumford, Maine, U.S.A., Manager of Chemical and Electro-Chemical Department.
1912. Griffiths, Clement S., Central Queensland Meat Export Co., Ltd., Lake's Creek, Rockhamptoo, Queensland, Chemist.
1909. Griffiths, E., 136, George Street N., Sydney, N.S.W., Australia, Chemist.
1902. Griffiths, Manfred E., Caizley House, Temple Road, Stowmarket, Suffolk, Explosives Chemist.
1912. Grimké-Drayton, Norman, Royal Mint Refinery, 19, Royal Mint Street, London, E., Metallurgist.
1902. Grimwade, Wilfrid R., 335—343, Spencer Street, West Melbourne, Vic., Australia, Manufacturing Chemist.
1900. Grimwood, Robt. G., 43, Leaside Avenue, Muswell Hill, N., Analytical Chemist.
O.M. Grindley, J., Upper North Street, Poplar, London, E., Tar Distiller.
1905. Grip, August E., 495, Columbia Street, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1888. Gripper, Harold, Great Central Railway, Gorton, Manchester, Analytical Chemist.
1909. Grist, John M., c/o Curtis's and Harvey, Ltd., Explosives Works, Cliffe-at-Hoo, Kent, Chemist.
1912. Groeling, Alb. von, 3, Lombard Street, London, E.C., Civil and Consulting Engineer.
1906. Groenewoud, Sidney H., 36, Grosvenor Road Highbury, N., Analytical Chemist.
O.M. Grossmann, Dr. J., 157, Plymouth Grove, Manchester, Consulting Chemist and Chemical Engineer.
1896. Grosvenor, Dr. W. M., Chemists' Building, 50, East 41st Street, New York City, U.S.A., Consulting Chemical Engineer.
1909. Grove, Daniel, "Yambo," Inverell, N.S.W., Australia, Diamond Buyer and Mine Owner.
O.M. Groves, C. E., F.R.S., 352, Kennington Road, London, S.E., Chemist (Thames Conservancy).
1907. Groves, J. Stuart, c/o E. I. du Pont de Nemours Powder Co., Georgetown, S.C., U.S.A., Chemist.
1899. Grudemann, Dr. E., 903, Postal Telegraph Building, Chicago, Ill., U.S.A., Chemist.
1915. Guelpa di Luigi, G., 41, Corso Dante, Turin, Italy, Manufacturer and Engineer.
1911. Guild, Edward J., Craiglea, Hartington Street, Leek, Staffs, Analytical Chemist.
1899. Guild, Frank N., University of Arizona, Tucson, Arizona, U.S.A., Professor of Chemistry.
1909. Gullick, Wm. A., Government Printing Office, Sydney, N.S.W., Government Printer.
1906. Gulline, Percy, c/o Columbia Textile Co., Lowell, Mass., U.S.A., Agent.
1904. Gundlach, Walter, 249, West 104th Street, New York City, U.S.A., Superintendent of Colour Works.
1905. Gundlich, Dr. Charles, c/o Thorium Chemical Co., Maywood, N.J., U.S.A., Technical Chemist.
1903. Gunn, Gilbert, 181, Bury New Road, Heywood, Lancs, Paper Mill Chemist.
1900. Gunther, Chas. E., Third Floor, Thames House, Queen Street Place, London, E.C., Merchant.
1910. Günther, C. M., Condong Mill, Tweed River, N.S.W., Sugar Chemist.
1903. Guthrie, Alan, Dept. of Industries, Post Box 454, Madras, India, Leather Chemist.
1901. Guthrie, John M., 199, Ferry Road, Leith, Scotland, Analytical Chemist.
1909. Gottmann, Camillo J., 60, Mark Lane, London, E.C., Chemical Engineer.
1903. Guttmann, Dr. Leo F., School of Mining, Queen's University, Kingston, Ont., Canada, Professor of Physical Chemistry and Chemical Engineering.
1912. Guy, Wm. W., 6, Cecil Road, Upton Manor, E., Analytical Chemist.
1913. Gyton, Walter J., British Standard Cement Works, Rainham, Kent, Chemist.

## H

1913. Haber, Prof. Dr. Fritz, Kaiser Wilhelm Institut, Faraday Weg 4, Post Lichterfelde 3, Berlin-Dahlem, Germany, Prof. of Physical and Electro-Chemistry.
1904. Hacking, D. H., Enfield Soap Works, Clayton-le-Moors, near Accrington, Soap Manufacturer.
1900. Haddock, Arthur G. *See* Haydock.
1887. Hadfield, Sir Robert A., F.R.S., Hecla Works, Sheffield; 22, Carlton House Terrace, London, S.W.; and (Journals) c/o J. E. Motimer, 220, Newhall Road, Attercliffe, Sheffield, Steel Founder.
1904. Hadley, Geo., Waterfall Lane, Blackheath, Staffs, Spelter Works Manager.
1887. Haig, Robert, Dollarfield, Dollar, Scotland, Chemical Engineer.
1904. Haigh, B. Wilson, By-Product Coke Oven Dept., Barnsley Main Colliery, Barnsley, Yorks, Chemical Engineer.
1896. Haigh, De Lagnel, 39, Hill Crest, Summit, N.J., U.S.A., Chemist.
1888. Hailes, A. J. de, 15, Red Lion Square, London, W.C., Analytical Chemist.
1910. Hailstone, Harold J., 44, Cordley Street, West Bromwich, Works Chemist.
O.M. Hake, C. Napier, Jnls. to c/o Dr. A. W. Hake, Medical School, Caxton Street, Westminster, S.W., Chemical Adviser.
1903. Halbert, Thos., c/o British South African Explosives Co., Modderfontein, Transvaal, Chemist.
1888. Hale, Edw. P., Endmoor, near Kendal, Analytical Chemist.
1887. Hall, Allan T., c/o Sissons Bros. and Co., Ltd., Hull, Oil Refiner and Varnish Manufacturer.
1905. Hall, Archibald A., Armstrong College, Newcastle-on-Tyne, Demonstrator in Chemistry.
1898. Hall, Clarence A., 167, West Durham Street, Mount Airy, Philadelphia, Pa., U.S.A., Chemist.
1909. Hall, Harold, 98, Birkin Avenue, Hyson Green, Nottingham, Analyst.
1885. Hall, Lt.-Col. Jno. A., Longstone, Esquimault Old Road, Victoria, B.C., Canada, Analytical Chemist.
1912. Hall, Robert H., Weardale Tar Works, Spennymoor, Co. Durham, Chemical Works Manager.
1896. Hall, Capt. S. Godfrey, East London Soap Works, Bow, E., Soap Maker.
1914. Hall, William A., Hall Motor Fuel, Ltd., Wilson's Wharf, Angel Road, Edmonton, N., Chemical Engineer.
1886. Haller, Geo., Sussex House, 52, Leadenhall Street, London, E.C., Chemical Merchant.
1893. Haller, H. Loft, 26, Scale Lane, Hull, Analytical Chemist.
1912. Halliday, McDonald, Oficina Buen Retiro, Pozo Almante, Iquique, Chile, Analytical Chemist.
1895. Halliwell, Edw., c/o Ribble Joint Committee, 2, Stanley Place, Preston, Chief Inspector.
1900. Hallock, Dr. Albert P., 3, James Street, Yonkers N.Y., U.S.A., Chemist.

1892. Hamaguchi, Gihei, IV., Toyoharacho, Komatsu-baratori, Wakayamashi, Japan, Soy Manufacturer.
1897. Hambly, Fred J., Buckingham, Quebec, Canada, Chemist.
1901. Hambuechen, Carl, 4, Pennsylvania Avenue, Bellevue, Ill., U.S.A., Secretary (American Carbon and Battery Co.).
1910. Hamburg, Dr. Max, c/o The British Diamalt Co., Sawbridgeworth, Herts, Chemist and Manager.
1911. Hamilton, David J., Locksley, Helensburgh, Dumbartonshire, Oil Refiner and Paint Manufacturer.
1904. Hamilton, Edward H., Virginia Smelting Works, West Norfolk, Va., U.S.A., Manager.
1912. Hamilton, James, 9, Esplanade Avenue, Whitley Bay, Northumberland, Analytical Chemist.
1884. Hamilton, Robert, Glengarnock Chemical Co., Ltd., Glengarnock, Ayrshire, Works Manager.
1892. Hamilton, Roht., 40, Sefton Terrace, Beeston Hill, Leeds, Analytical Chemist.
1898. Hammersley, W. Stanley, Rue Champbertrand, Sens (Yonne), Franco, Tanner.
O.M. Hammill, M. J., The Gables, St. Helens, Alkali Manufacturer.
O.M. Hammond, J., Gas Works, Easthourne, Sussex, Gas Manager.
1905. Hancock, Thos. J., 8011, Panola Street, New Orleans, La., U.S.A., Chemist.
1900. Hancock, Walter C., 10, Upper Chadwell Street, Myddelton Square, London, E.C., Chemist.
1896. Hand, Daniel, 30, Mount Pleasant Avenue, Newark, N.J., U.S.A., Chemist.
1888. Hanks, Ahbot A., 630, Sacramento Street, San Francisco, Cal., U.S.A., Assayer.
1901. Hanna, Charles E., P.O. Box 600, Montreal, Canada, Secretary.
1905. Hanson, H. Norman, The Oaks, Huddersfield Road, Brighouse, Yorks, Research Assistant.
1908. Hanson, W. G., c/o United States Glue Co., Milwaukee, Wis., U.S.A.
1909. Harbord, F. W., 16, Victoria Street, Westminster, S.W., Consulting Metallurgist.
1905. Harcourt, Prof. R., Ontario Agricultural College, Guelph, Ont., Canada, Professor of Chemistry.
1904. Hard, Dr. James M. B., 422, Gravier Street, New Orleans, La., U.S.A., Chemist and Pathologist.
1901. Hardcastle, G. Fred., 307, East Park Road, Leicester, Teacher of Science and Technology.
1894. Harden, Dr. Arthur, F.R.S., 5, Cambridge Gardens, Marlborough Road, Richmond, Surrey, Lecturer in Chemistry.
1910. Hardie, Thos., Newcastle and Gateshead Gas Co., Tyneside Road, Newcastle-on-Tyne, Gas Engineer.
1915. Harding, Gilbert, 1, Holmewood Gardens, Brixton Hill, S.W., Chemist.
1912. Hardwick, Walter A. N., 26, West Kensington Mansions, London, W., Chemist.
1900. Hardwick, W. Roscoe, 13, Batavia Buildings, Hackins Hey, Liverpool, Chemist.
1905. Hardy, Chas. H., 16, Westhourne Avenue, Hull, Chemist.
1907. Harfeld, Louis E., c/o Messrs. Ohlenschlager Bros., Shanghai House, Botolph Lane, London, E.C., Merchant.
1913. Harger, Dr. John, Grange Hollies, Gateacre, Liverpool.
1914. Hargreaves, C. H., Houghton House, Worsley Road, Swinton, Manchester, Analyst.
1906. Hargreaves, Frank, Hough Green, Widnes, Chemist.
O.M. Hargreaves, Jno., Widnes, Alkali Manufactnrer.
1904. Harker, Dr. George, Mount Errington, Hornsby, Sydney, N.S.W., Australia, Chemist.
1909. Harland, Robert M., 37, Lombard Street, London, E.C., Analytical Chemist and Assayer.
1893. Harlock, E. B., Newton House, Middlewich, Chemical Manufacturer.
1898. Harman, Edw. A., Gas Works, Huddersfield, Gas Engineer, M.Inst.C.E.
1905. Harper, Dr. Henry W., University of Texas, 2216, Rio Grande Street, Austin, Texas, U.S.A., Professor of Chemistry.
1912. Harper, J. G., Kynochtown, Stanford le Hope, Essex, Managing Chemist.
1913. Harper, William, P.O. Box 174, Sannomiya, Kobe, Japan, Works Chemist.
1912. Harran, Dr. Edward B., Abbey Field, Sandbach, Cheshire, Chemist.
1893. Harris, Arthur, 22, Marsh Gate Lane, Stratford, E., Soap Maker.
1885. Harris, Booth, jun., Becleigh, Victoria Road, Buckhurst Hill, Essex, Soap Maker.
1897. Harris, Fred. W., 20, Trongate, Glasgow, Public Analyst.
1906. Harris, Jonathan W., c/o Western Electric Co., 463, West Street, New York City, U.S.A., Chemist.
1914. Harris, J. W., Lindum House, Swallowbeck, Lincoln, Chemist.
1914. Harris, Joseph, H., 994, Danforth Avenue, Toronto, Canada, Superintendent.
1907. Harris, Thos. E., c/o The Union Acid Co., 17, Cooper Street, Manchester, Chemical Merchant.
1906. Harris, Wm. G., jun., 35, Fraser Avenue, Toronto, Canada, Metallurgist.
1905. Harrison, E. F., Langholm, Edgar Road, South Croydon, Analytical Chemist.
1909. Harrison, Edwin D., 86, Harrison Place, Irvington, N.J., U.S.A., Celluloid Manufacturer.
1883. Harrison, G. Herbert, Hagley, Stourbridge, Firebrick Maker.
1892. Harrison, Prof. John B., C.M.G., Government Laboratory, Georgetown, British Guiana, Chemist.
1907. Harrison, W., 3, Regent Terrace, Hyde Park, Leeds, and (Jnls.) Fuel Dept., The University, Leeds, Technical Investigator.
1896. Hart, Bertram, c/o Tennants and Co., Clayton, Manchester, Analyst.
1886. Hart, Bertram H., Rosslyn, High Street, Sidcup, Kent, Analytical Chemist.
O.M. Hart, Dr. E., Gayley Hall, Lafayette College, Easton, Pa., U.S.A., Professor of Chemistry.
1890. Hart, H. W., Winthrop, Ansdell Road, Lytham, Lancashire, Analytical Chemist.
1897. Hart, Wm. Beamont, Manchester Laboratory, 8, Exchange Street, Manchester, Consulting Chemist.
1908. Hartley, Bernard C., 56, Wood View, Manningham, Bradford, Analytical Chemist.
1912. Hartley, Harold, c/o The Richmond Gas Stove and Meter Co., Ltd., Warrington, Research Chemist.
1883. Hartley, Joseph, 73, East Road, Stockport Road, Longsight, Manchester, Technical Chemist.
1912. Hartley, Thos., 64, Westlecot Road, Swindon, Wilts, Teacher of Technical Chemistry.
1905. Hartshorne, Wm. D., Arlington Mills, Methuen, Mass., U.S.A., Agent.
1901. Hartwell, S. Warren, 120 North Fourth Street, Easton, Pa., U.S.A., Chemist.
1908. Harvey, Arthur J., 16, Acresfield Road, Pendleton, Manchester, Chemist.
1885. Harvey, Ernest W., 36, Arthur Road, Wimbledon Park, London, S.W., A.R.S.M., Engineer.
1913. Harvey, Hildehrand W., Hutton Mount, Brentwood, Essex, Research Chemist.
1891. Harvey, Sidney, South-Eastern Laboratory, Canterbury, Analytical Chemist.
1899. Harvey, Thos. F., 69, North Road, West Bridgford, Nottingham, Analyst (Drug Co.).
1883. Harvey, T. H., Cattedown, Plymouth, Chemical Manufacturer.
1903. Hasenclever, Max, Chemische Fabrik Rhenania, Aachen, Prussia, Chemical Manufacturer.
1906. Haskell, Walter F., 234, Bridge Street, Westbrook, Maine, U.S.A., Textile Chemist and Colourist.
1900. Haslwanter, Chas., 447, Spruce Street, Richmond Hill, Long Is., N.Y., U.S.A., Analytical Chemist.
1897. Hasslacher, Jacob, P.O. Box 1999, New York City, U.S.A., President, Roessler-Hasslacher Chemical Co.

1903. Hatschek, Emil, c/o S. Bornett and Co., Ltd., 19, St. Dunstan's Hill, London, E.C., Engineer.
1887. Hatton, Wm. P., c/o W. R. Hatton and Sons, Wormwood Scrubbs, W., Starch Works Manager.
1906. Havercroft, Arthur E., Glenholme, Westbourne Road, Hornsea, Yorks, Chemist.
1899. Hawdon, H. S., Cleadon, near Sunderland, Chemical Works Manager.
1895. Hawker, E. W., Gladstone Chambers, Adelaide, South Australia, Metallurgist.
1910. Hawkes, Cornelius A., 43, Painswick Road, Gloucester, Analytical Chemist.
1902. Hawkins, Clement C., c/o The Texas Co., Port Neches, Texas, U.S.A., Chemist.
1897. Hawkins, Ernest M., Watling Chambers, Canterbury, Analytical Chemist.
1905. Hawkins, Henry, Moyola Villa, Lansdown, Limerick, Ireland, Gas Engineer.
1887. Hawliczek, Josef, c/o United Alkali Co., Intelligence Dept., Widnes, Consulting Chemical Expert.
1899. Haworth, Dr. Edw., Ivy Bank, Moughland Lane, Runcorn, Cheshire, Chemist.
1910. Haworth, John, 117, Millhouses Lane, Sheffield, Chemist and Sewage Works Superintendent.
1904. Hawthorn, J. H., Municipal Technical School, Leicester, Head Master.
1915. Hay, Alex H., Essex Wharf, Narrow Street, Limehouse, E., Caramel Manufacturer.
1914. Hay, George S., 24, Chetwynd Road, Highgate, N., Analytical Chemist.
1910. Hay, J. Gordon, 37, Worcester Road, Bootle, Liverpool, Analytical Chemist.
1915. Hay, William, 121, St. Vincent Street, Glasgow, Secretary.
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1900. Haydock, A. G., c/o The Castner-Kellner Alkali Co., Wallsend-on-Tyne, Technical Chemist.
1909. Haydon, James R., 91, Ampthill Road, Aigburth, Liverpool, Works Manager and Chemist.
1894. Haynes, David O., 82, Fulton Street, New York City, U.S.A., Proprietor, "Pharmaceutical Era."
1902. Hays, B. F., c/o E. R. Squibb and Sons, 80, Beekman Street, New York City, U.S.A., Pharmaceutical Chemist.
1906. Hayworth, W. P., 24, Tower Road, Dartford, Kent, Chemist.
1905. Hazard, Fred R., P.O. Box 2, Syracuse, N.Y., U.S.A., President (Solvay Process Co.).
1903. Hazen, Chas. R., 258, Prince Albert Avenue, Westmount, Quebec, Canada, Chemist.
1894. Heal, Carlton B., Hill Crest, Runcorn, Cheshire, Tanner.
1912. Healey, E., jun., St. Mary's Mills, Leicester, India-rubber Manufacturer.
1905. Heathcote, Henry L., c/o Rudge-Whitworth, Ltd., Coventry, Research Chemist.
1904. Heaton, Lieut. Noel, 72, Abbey Road, London, N.W.; (Jnls.) Imperial Hotel, Tenby, South Wales, Colour Manufacturer.
1905. Heberlein, Dr. Edw., c/o H. T. Enthoven and Sons, Ltd., 247, Rotherhithe Street, London, S.E., Works Manager.
1889. Hecht, Jos. L., c/o French and Hecht, Davenport, Iowa, U.S.A., Analytical Chemist.
1900. Heckman, J. Conrad, Larkin Soap Manufacturing Co., Seneca Street, Buffalo, N.Y., U.S.A., Chemist.
1911. Hector, Alex. B., c/o Burroughs, Wellcome and Co., 481, Kent Street, Sydney, N.S.W., Australia, Manager.
1885. Hedley, Armorer, Durrant House, Bournemouth, Hants.
1912. Hedley, Dr. Edgar P., Cape Explosives Works, Somerset West, C.C., South Africa, Chemist.
1902. Heebner, Prof. C. F., Ontario College of Pharmacy, Toronto, Canada, Professor of Chemistry.
O.M. Hehner, Otto, 11, Billiter Square, London, E.C., Analytical and Consulting Chemist.
1908. Heilmann, Dr. Ernst, Güstrow, Mecklenburg, Germany, Chemical Manufacturer.
1914. Heinemann, Dr. A., The D.R. Syndicate, Ltd., Ryder's Green, West Bromwich, Research Chemist.
1887. Hellier, E. A., Avonside Varnish Works, St. Philip's Marsh, Bristol, Varnish Manufacturer.
1885. Hellon, Dr. R., 40, New Lowther Street, Whitehaven, Analytical and Consulting Chemist.
1903. Helps, D. H., c/o Reading Gas Co., King's Road Works, Reading, Engineer and Manager.
1898. Hemingway, Frank C. R., 1, Broadway, New York City, and (Journals) 6, East Union Avenue, Bound Brook, N.J., U.S.A., Chemical Manufacturer.
1883. Hemingway, H., 9, Albemarle Mansions, Heath Drive, Hampstead, N.W., Chemical Manufacturer.
1903. Hemstreet, George P., Hastings-on-Hudson, N.Y., U.S.A., Mechanical Engineer.
1910. Henderson, Ernest G., c/o Canadian Salt Co., Ltd., Windsor, Ont., Canada, Vice-President and Manager.
1883. Henderson, Prof. G. G., Royal Technical College, George Street, Glasgow, Professor of Chemistry.
1902. Henderson, Dr. Jas. A. Russell, Stranord, West Kilbride, Ayrshire, Professor of Chemistry and Physics.
1894. Henderson, Jos., Eskbank Ironworks, Lithgow, N.S.W., Australia, Blast Furnace Manager.
1894. Henderson, Norman M., Broxburn Lodge, Broxburn, Scotland, Oil Works Manager.
1915. Henderson, T. A., 93, Roxborough Street West, Toronto, Canada, Chemical Works Manager.
O.M. Henderson, W. F., Moorfield, Claremont Gardens, Newcastle-on-Tyne.
1893. Hendrick, Prof. Jas., Marischal College, Aberdeen, Professor of Agriculture.
1906. Henius, Dr. Max, 1135—1147, Fullerton Avenue, Chicago, Ill., U.S.A., Secretary, Brewers' School.
1912. Henley, Andrew T., Lady's Well Brewery, Cork, Ireland, Technical Chemist.
1904. Henley, Hon. F. R., 49, Montagu Square, London, W., Brewer's Chemist.
1905. Henning, Albert, c/o Hedley and Co., 92, Harrow Road, Leytonstone, N.E., Ester Manufacturer.
1906. Henning, C. I. B., c/o E. I. du Pont de Nemours Powder Co., Experimental Station, P.O. Henry Clay, Del., U.S.A., Chemist.
1914. Henshaw, D. M., c/o W. C. Holmes and Co., Ltd., Whitestone Ironworks, Huddersfield, Chemical Engineer.
1894. Henshaw, Sam., Glenthorne, Wolstanton, Stoke-on-Trent, Chemical Works Manager.
1910. Hepburn, Edward, Priory Works, Dartford, Kent, Tanner.
1883. Hepworth-Collins, W., Junior Constitutional Club, Piccadilly, London, W.; retain Journals, Civil Engineer.
1914. Herdsman, Frank, 144, Wellington Street, Glasgow, Consulting Chemist and Metallurgist.
1906. Herig, Harry W., c/o General Chemical Co., Hudson River Works, Edgewater, N.J., U.S.A., Chemist.
1897. Heriot, T. H. P., Royal Technical College, Glasgow, Lecturer in Sugar Manufacture.
O.M. Herman, W. D., Holm Lea, Rainhill, Lancashire, Glass Works Chemist.
1903. Herreshoff, J. B. F., 620, West End Avenue, New York City, U.S.A., Chemical Engineer.
1887. Herriot, Wm. Scott, Clarewood, Thorntonhall, Lanarkshire, Mechanical Engineer.
O.M. Herrmann, R. W., 59, Mark Lane, London, E.C., Chemical Merchant.
1891. Hersam, Ernest A., University of California, Berkeley, Cal., U.S.A., Associate Professor of Metallurgy.
1898. Hersey, Dr. Milton L., P.O. Box 1086, Montreal, Canada, Consulting Chemist.
1906. Herty, Prof. Chas. H., University of N. Carolina, Chapel Hill, N.C., U.S.A., Professor of Chemistry.
1906. Herz, Dr. Albert, c/o John Crossley and Sons, Ltd., Halifax, Yorks, Chemist.

1907. Hess, Artbur F., c/o A. Hess and Bro., Ltd., Kirkstall Road, Leeds, Oil Distiller.
1905. Hesse, Dr. Bernhard C., 90, William Street, New York City, U.S.A., Chemist.
1891. Hetherington, Dr. Alhort E., Ammonia Soda Works, Fleetwood, Lancashire, Analytical Chemist.
1894. Hewitt, A. H., The Green Island Cement Co., Ltd., Hong Kong, China, Engineer.
1910. Hewitt, Arthur, c/o Consumers' Gas Co., 19, Toronto Street, Toronto, Canada, General Manager.
O.M. Hewitt, Dr. D. B., 28, Queen's Gardens, Hyde Park, London, W., Alkali Manufactnrer.
1896. Hewitt, Dr. J. Theo., F.R.S., Clifford House Bedfont, Middlesex, Lecturer.
1890. Hewlett, John C., 40—42, Charlotte Street, Great Eastern Street, London, E.C., Mannfacturing Chemist.
1907. Hewson, Geo. W., Grasmere, Field Terrace, Jarrow-on-Tyne, Analytical Chemist.
1893. Hey, Harry, 2, Ash Terrace, Savile Town, Dewsbnry, Dyer.
1894. Heyl, G. Edward, 61-62, Lincoln's Inn Fields, London, W.C., Chemical and Electrical Engineer.
1906. Heys, Charles H., Toronto Arcade, Toronto, Canada, Consnlting Chemist.
1915. Hibbert, Gilbert S., Bnckton Vale Print Works, Stalybridge, Cheshire, Printworks Manager.
1901. Hiby, Dr. Walter, c/o The Otto Hilgenstock Coke Oven Co., Ltd., Post Office House, Leeds, Chemical Engineer.
1906. Hicking, W. Norton, Queen's Road Works, Nottingham, Lace Dresser.
1906. Hickman, T. Moore, Oakleigh, Tettenhall Wood, Wolverhampton, Analyst.
1897. Hicks, Edwin F., 4837, Fairmount Avenue, Philadelphia, Pa., U.S.A., Analytical Chemist.
O.M. Higgin, W. H., c/o C. J. Schofield, Ltd., Alkali Works, Clayton, Manchester, Chemical Manufacturer.
1913. Higgins, A. Howard, Metallurgist.
1915. Higgins, C. A., c/o The New Explosives Co., Ltd., 62, London Wall, London, E.C., Works Chemist.
1886. Higgins, C. L., 41, Knowsley Road, Cressington Park, Liverpool, Manufacturing Chemist.
1905. Higgins, Dr. Eric, Chemist.
1905. Higgins, John M., 39, Queen Street, Melbourne, Vic., Australia, Consulting Metallurgist.
1908 Higgins, S. H., Luncarty Bleachfield, Perth, Chemist and Asst. Manager.
1909. Higson, Frank, 52, Chapel Street, Salford, Manchester, Analytical Chemist.
1909. Higuchi, Ken-ichi, Central Laboratory, South Manchuria Railway Co., Dairen, Manchuria, Chemical Engineer.
1911. Hilditch, T. P., Birchdene, Cross Lane, Grappenhall, Warrington, Research Chemist.
1903. Hill, Chas. Alex., c/o British Drug Houses, Ltd., 22—30, Graham Street, City Road, N., Chemist.
1897. Hill, Dr. Herbert M., 20, West Eagle Street, Buffalo, N.Y., U.S.A., City Chemist.
1907. Hill, James A., 8, Highfield Crescent, Rock Ferry, Cheshire, Technical Chemist.
1908. Hill, J. H. F., c/o Broken Hill Proprietary Co., Steel Works, Newcastle, N.S.W., Australia, Superintendent, Coke and By-Product Plant.
O.M. Hill, J. K., 13, Osborne Place, Ibrox, Glasgow, Manufacturing Chemist.
1892. Hill, Sydney, c/o Blundell, Spence, and Co., Ltd., Hull, Analytical Chemist.
1903. Hill, W. Basil, Foss Islands Tannery, York, Tanner.
1902. Hill, Wm. G., jun., c/o Apsley Rubber Co., Hudson, Mass., U.S.A., Chemist.
1898. Hill-Jones, Thos., Invicta Mills, Bow Common Lane, London, E., Manufacturing Chemist.
1894. Hills, Harold F., Commercial Gas Works, Stepney, London, E., Analytical Chemist.
O.M. Hills, W., Oxford Works, Tower Bridge Road, London, S.E., Pharmaceutical Chemist.
1899. Hinchley, J. W., 55, Redcliffe Road, London, S.W., Chemical Engineer.
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O.M. Hindle, J. H., 8, Cobham Street, Accrington, Dyeworks Manager.
1909. Hinks, Edward, 16, Southwark Street, London, S.E., Analyst.
1899. Hinks, Percy J., Danger Building Dept., Royal Laboratory, Woolwich Arsenal, S.E., Chemist.
1891. Hinman, Bertrand C., Coventry House, South Place, Finsbury, London, E.C., Metallurgical Chemist.
1912. Hinman, Jack J., jun., 1, Bloom Terrace, Iowa City, Iowa, U.S.A., Laboratory Director.
1909. Hirsch, Fritz, 51, Ferndale Avenue, Wallsend-on-Tyne, Analytical Chemist.
1914. Hirschberg, Dr. Leon, 20, Birchington Road, Crouch End, N., Chemical Engineer.
1914. Hirst, A. Norman, Box 1141, Durban, South Africa, Consulting Chemist.
1895. Hirst, H. Reginald, Bank House, Staincliffe, Batley, Yorks, Works Chemist.
1907. Hirt, Wilhelm B., c/o Cuming, Smith, and Co., Ltd., Yarra Junction, Vic., Australia, Analytical Chemist.
1896. Hislop, Geo. R., (Journals) Gas Works, (communications) Greenhill House, Underwood Road, Paisley, Gas Engineer and Manager.
1913. Hitchcock, Thos. J., 28, Albany Road, Manor Park, Essex, Technical Chemist.
1914. Hoare, Capt. F. R. J., 27, Eccleston Square, London, S.W., Ordnance Dept., South African Forces.
1906. Hobsbaum, I. B., c/o Messrs. Anthony Gibbs & Sons, 22, Bishopsgate, London, E.C., Chemist.
1905. Hobson, Alfred, Dantzic Brewery, Imperial Street, Regent Street, Leeds, Brewer and Wine Manufacturer.
1909. Hodgart, Matthew, Vulcan Works, Paisley, Engineer.
1894. Hodge, Andrew, Glenariff, Whaley Bridge, near Stockport, Printworks Chemist.
1913. Hodgetts, E. A. Brayley, 36, Elvaston Place, Queen's Gate, S.W.
1915. Hodgkinson, S. E., Tobacco Factory, Sharp Street, Rochdale Road, Manchester, Works Analyst.
O.M. Hodgkinson, Dr. W. R., 89, Shooter's Hill Road, Blackheath, S.E., Professor of Chemistry.
O.M. Hodgson, Chris., 33, Oakdale Road, Nether Edge, Sheffield, Metallurgical Chemist.
1913. Hodgson, Cyril V., 52, London Road, Chesterton, North Staffordshire, Works Chemist.
1897. Hodgson, Matthew, Ardmore, Church Hill, Wicklow, Ireland, Technical Chemist.
1890. Hodgson, Wm., 66, Deansgate, Manchester, Oil and Colour Broker.
1910. Hodsman, Henry J., Dept. of Fuel and Coal Gas Industries, The University, Leeds, Chemist.
1900. Hogarth, Julius W., The University, Sydney, N.S.W., Australia, Demonstrator of Chemistry,
1886. Hogben, W., Lampeter House, Exeter Park, Bournemouth, Celluloid Works Manager.
O.M. Hogg, T. W., c/o John Spencer and Sons, Newburn Steelworks, Newcastle-on-Tyne, Metallurgical Chemist.
1905. Holcroft, Harold, Parkdale, Wolverhampton, Iron founder.
1887. Holden, G. H., Manchester Oxide Co., Ltd., Canal Street, Miles Platting, Manchester, Chemist.
1904. Holden, Norman N., c/o Hardman and Holden, Ltd., Miles Platting, Manchester, Manufacturing Chemist.
1902. Holdsworth, Ernest T., "Holme Dene," Crossley Hall, Bradford, Dyer.
1885. Holgate, T. E., 173, Hollins Grove, Darwen, Lancashire, Metallurgist.
O.M. Holland, Philip, 22, Taviton Street, Gordon Square, London, W.C., Analytical Chemist.
1892. Holland, Philip H., 546, Sherbrooke Street West, Montreal, Canada, Merchant.
1909. Holliday, F.E., 81, Fulton Street, New York City, U.S.A.

1896. Hollings, J. Spencer, Brymbo, North Wales, Works Manager.
1909. Hollingworth, David V., Birchenwood Collieries, Kidsgrove, Stoke-on-Trent, Gas Analyst.
1903. Hollinshead, Peter, The Beeches, Weston Road, Runcorn, Cheshire, Chemist.
1900. Hollinshead, Dr. Warren H., Wingrove Avenue, Nashville, Tenn., U.S.A., Teacher of Chemistry.
1904. Holloway, E. G., c/o Jas. S. Kirk and Co., 360, North Water Street, Chicago, Ill., U.S.A., Chemist.
1890. Holloway, G. T., 9-13, Emmett Street, Limehouse, London, E., Chemist and Metallurgist.
1883. Holmes, Ellwood, Wyncote, Jesmond Park East, Newcastle-on-Tyne, Colour Manufactorer.
O.M. Holmes, F. G., Thames Tar Works, Lower Road, Northfleet, Kent, Tar and Ammonia Distiller.
1914. Holroyd, Thomas A., Carnatic House, Peramhore Barracks, Madras, India, Colour Chemist.
1913. Holt, Dr. Alfred, Dowsefield, Allerton, Liverpool, University Reader in Physical Chemistry.
1900. Holthouse, Harold B., 106, Radcliffe Road, West Bridgford, Notts, Chemist.
1902. Holton, Alf. L., Chemical Dept., Gas Works, Bradford Road, Manchester, Chemist.
1892. Holton, E. C., 601, Canal Road, N. W., Cleveland, Ohio, U.S.A., Chemist.
1893. Holzapfel, Max, c/o Holzapfels, Ltd., Felling-on-Tyne, Manufacturer.
1893. Homfray, D., Analytical Chemist.
1909. Hook, Russell W., 8, Holton Street, West Medford, Mass., U.S.A.
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1889. Hooper, Ernest F., c/o Brotherton and Co., Ltd., Wear Tar Works, South Dock, Sunderland, Technical Chemist.
1888. Hope, Jas., The Knoll, Lenzie, near Glasgow, and (Journals) The Nickel Co., Kirkintilloch, by Glasgow, Nickel Works Manager.
1904. Hopewell, Fredk., 59, William Street, Montreal, Canada, Manager.
1892. Hopkins, Erastus, "The Warrington," 161, Madison Avenue, New York City, U.S.A., Consulting Chemist.
1905. Hoppenstedt, A. W., c/o Schoellkopf and Co., Perry and Mississippi Streets, Buffalo, N.Y. U.S.A., Chemist.
1895. Horne, Dr. W. D., 175, Park Avenue, Yonkers, N.Y., U.S.A., Consulting Chemist.
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1913. Horrocks, Herbert, 253, Jelliff Avenue, Newark, N.J., U.S.A., Chemist.
1914. Horrocks, John M., "Maywood," Osborne Road, Levenshulme, Manchester, Tar Distiller and Manufacturing Chemist.
1900. Horsfall, Jno., 4, Grange Avenue, Rawtenstall, Manchester, Analytical and Consulting Chemist.
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1890. Hoskins, A. Percy, Clonlee, Rosetta Park, Belfast, Ireland, Analytical Chemist.
1899. Hoskins, Wm., 2009, Harris Trust Building, 111, West Monroe Street, Chicago, Ill, U.S.A., Chemist.
1914. Hough, Alex. T., 95, Abbeyfield Road, Rotherhithe, S.E., Chemist.
1911. Hough, Samuel, c/o Lever Bros., Ltd., Balmain, Sydney, N.S.W., Australia, Chemist.
1899. Houlder, Bertram E., 50, Lady Margaret Road, Southall, Middlesex, Chemist.
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1887. Howard, D. Lloyd, Uphall Works, Ilford, Essex, Chemical Manufacturer.
1898. Howard, Henry, 36, Amory Street, Brookline, Mass., U.S.A., Chemical Engineer.
1902. Howard, Nelson A., c/o General Chemical Co. of California, 705, Royal Insurance Building, San Francisco, Cal., U.S.A., General Manager.
1915. Howard, O. McG., Paint, Oil and Drug Review, 212, West Washington Street, Chicago, Ill., U.S.A., President and Journalist.
1913. Howard, Tom, 320, Wellington Road, Heaton Chapel, Stockport, Cheshire, Chemist.
1906. Howe, Chester A., 135, Oliver Street, Boston, Mass., U.S.A., Dyestuff Merchant.
1903. Howe, Jas. Lewis, Washington and Lee University, Lexington, Va., U.S.A., Professor of Chemistry.
1912. Howe, Dr. Percy R., 536, Pleasant Street, Belmont, Mass., U.S.A., Dentist.
1904. Howell, Walter L., Room 314, Custom House, New Orleans, La., U.S.A., Chemist.
1899. Howles, Fred., o/o McDougall Bros., 66—68, Port Street, Manchester, Chemist.
1889. Howorth, F. Wise, 10, New Court, Lincoln's Inn, W.C., Technical Chemist and Chartered Patent Agent.
1907. Howroyd, Richard R., o/o Calder Mersey Extract Co., Ltd., Ditton, near Widnes, Chemist.
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1906. Hoyler, Fritz, 93, Market Street, Perth Amboy, N.J., U.S.A., Chemist.
1896. Hoyte, Percy S., Gas Works, Coxside, Plymouth, Gas Engineer.
1900. Hübner, Julius, Linden, Cheadle Hulme, Cheshire; Director of Dyeing and Papermaking Departments (Municipal School of Technology).
1909. Hudson, Baker, Public Library, Middleshrough, Librarian.
1899. Hudson, Dr. Edw. J., c/o Pioneer Iron Co., Marquette, Mich., U.S.A., Chemist.
1914. Hudson, Norman, S. W., Eskbank Iron and Steel Works, Lithgow, New South Wales, Analytical Chemist.
1905. Hudson, O. F., The University, Edghaston, Birmingham, Lecturer on Metallurgy.
O.M. Hughes, J., 79, Mark Lane, London, E.C., Agricultural Chemist.
1908. Hughes, Wm. E., Electro Chemist.
1906. Hulme, Robert B., 1162, Union Avenue, Memphis, Tenn., U.S.A., Chemical Engineer and Manager.
1909. Hultman, G. H., St. Paulsgatan 31, Stockholm, Sweden, Chemical Engineer.
1905. Hulton, H. F. E., 15, Oak Hill Court, Putney, S.W., Chemist.
1905. Humel, Edward J., 13315, Detroit Street, Lakewood, Cleveland, Ohio, U.S.A., Chemist.
1893. Humfrey, Chas., Homewood, Hartford, Cheshire, Alkali Works Manager.
1902. Humphrey, Richard L., 1001, Harrison Building, Philadelphia, Pa., U.S.A., Civil Engineer.
1903. Humphreys, A. C., 165, Broadway, New York City, and (Jnls.) Stevens Inst. of Technology, Hoboken, N.J., U.S.A., Engineer.
1908. Humphries, Albert E., Coxes Lock Mill, Weybridge, Surrey, Flour Miller.
1912 Humphries, Herbert B. P., Queen Anne's Chambers, Westminster, S.W., Consulting Chemist.
O.M. Humphrys, N. H., Gasworks, Salisbury, Wilts., Gas Engineer.
1900. Hunt, Arthur V., 19, Park Road, Port Sunlight, Cheshire, Analytical Chemist.
O.M. Hunt, Chas., 17, Victoria Street, Westminster, London, S.W., Civil Engineer.
1883. Hunt J. S., Appleton, Widnes.

1903. Hunt, P. C. Holmes, 99, Queen Street, Melbourne, Vic., Australia, Gas Engineer.
O.M. Hunt, W., Hampton House, Wood Green, Wednesbury, Staffordshire, Chemical Manufacturer.
1893. Hunter, Prof. Matthew, Rangoon College, Rangoon, Burmah, Professor of Chemistry.
O.M. Huntington, Prof. A. K., King'e College, Strand, London, W.C., Professor of Metallurgy.
1902. Huntly, Geo. N., 14, Old Queen Street, Westminster, S.W., Analytical and Consulting Chemist.
1904. Hurren, F. H., c/o The Rover Co., Ltd., Coventry, Analytical Chemist.
1894. Hurry, E. H., Llanover, Churt, Farnham, Surrey, Mechanical Engineer.
1894. Hutcheson, Jno. F., 39, St. Enoch Square, Glasgow, Chemical Manufacturer.
1912. Hutchin, C. D., c/o Messrs. Meredith and Drew, Ltd., High Street, Shadwell, London, E., Biscuit Manufacturer.
O.M. Hutchinson, T. J., Aden House, Manchester Road, Bury, Analytical and Consulting Chemist.
1909. Hutchison, Chas. F., Eastman Kodak Co., Kodak Park, Rochester, N.Y., U.S.A., Photographic Emulsion Maker.
1909. Hütz, Dr. R., 32, India Street, Boston, Mass., U.S.A., Colour Chemist.
O.M. Huxley, Jas. H., c/o Vickers, Son, and Maxim, Ltd., River Don Works, Sheffield, Metallurgical Chemist.
1906. Huyett, Miles C., 1005, Morgan Building, Buffalo, N.Y., U.S.A., Mechanical Engineer.
1897. Hyams, Godfrey M., 312, Sears Building, Boston, Mass., U.S.A., Mines Manager.
1902. Hyde, Austin T., Box 98, Rumford Falls, Maine, U.S.A., Chemical Engineer.
1897. Hyde, B. T. Babbitt, 11, Broadway, New York City, U.S.A., Soap Manufacturer.
1899. Hyde, Fred. S., 215, Schermerhorn Street, Brooklyn, N.Y., U.S.A., Research Chemist.
1899. Hyde, Wm. Grantley, Garden Wharf, Church Road, Battersea. S.W.. Assayer.
1901. Hyman, Leonard W., 342, South Pearl Street, Albany, N.Y., U.S.A., Analytical Chemist.

1900. Ichioka, Dr. Tajiro, 19, Maruyama, Shinmachi, Hongo, Tokio, Japan, Chemist (Imperial Japanese Navy).
1906. Iddings, Richard P., Arlington Mills, Lawrence, Mass., U.S.A., Chemist.
1885. Idris, T. H. W., M.P., 120, Pratt Street, Camden Town, N.W., Mineral Water Manufacturer.
1913. Illingworth, S. R., c/o Gas Lighting Improvement Co., Ltd., Pacific Wharf, West Ham, E., Works Chemist.
1909 Imison, C. S., The Cottage, Runcorn, Cheshire, Chemist, United Alkali Co.
1900. Imrie, John, 83, Horndean Road, Firth Park, Sheffield, Producer Gas and By-Products Plant Manager.
1900. Ingalls, Walter R., "Engineering and Mining Journal," 10th Avenue at 36th Street, New York City, U.S.A., Mining Engineer and Metallurgist.
1889. Ingle, Dr. Harry, 26, Bond Street, Leeds, Organic Chemist.
1909. Ingleby, G. W., c/o John L. Seaton and Co., Ltd., Sculcoates, Hull, Director.
1906. Inglis, Dr. Jno. K. H., University of Otago, Dunedin, New Zealand, Professor of Chemistry.
1912. Inglis, Robert J. C., c/o Curtis's and Harvey, Ltd., Powder Mills, Dartford, Kent, Analytical Chemist.
1911. Innes, Dr. Alfred G., 14, Great Queen Street, Kingsway, London, W.C., Technical Chemist.
1909. Innes, R. Faraday, c/o The British Chrome Tanning Co., St. Andrew's Tannery, Northampton, Chemist.
1906. Innes, Dr. Wm. Ross, 19, St. James' Avenue, Cricklewood, N.W., Chemist.
1910. Irvine, Prof. J. C., Chemical Research Laboratory, The University, St. Andrews, Scotland, Professor of Chemistry.
1884. Irving, J. M., 17A, Dickinson Street, Cooper Street, Manchester, Chemical Merchant.
1911. Irwin, George C., c/o S. H. Johnson and Co., Ltd., Carpenter's Road, Stratford, E., Manager (Engineering Works).
O.M. Irwin, W., Derwent Lodge, Cockermouth, Analytical Chemist.
1901. Isakovics, Alois von, Synfleur Scientific Laboratories, Monticello, N.Y., U.S.A., Manufacturing Chemist.
1915. Isherwood, Dr. Percy C. C., c/o W. J. Bush & Co., Ltd., Hackney, N.E., and (Journals) Moss Cottage, Bushey Heath, Herts, Chief Chemist.
1900. Ittner, Dr. Martin H., c/o Colgate and Co., Jersey City, N.J., U.S.A., Soap and Essential Oil Chemist.
1912. Ivatt, Albert, The Engadine, Histon, Cambridge, Chemist (Foods).
1908. Ives, Herbert, 125, Pearl Street, Boston, Mass., U.S.A., Manager (Dyestuffs, etc.).

1890. Jackman, E. J., 60, Belgrave Road, Ilford, Essex, Technical Chemist.
O.M. Jackson, Edward, Raven's Cliff, Oxford Road, Moseley, Birmingham, Alkali Works Inspector.
1904. Jackson, Ernest W., Godrevy, Saltburn, Yorks, Analytical Chemist.
1991. Jackson, F., Smedley Bridge Works, Cheetham, near Manchester, Bleacher and Dyer.
1883. Jackson, Frederick, 44, Chapel Street, Salford, Manchester, Laboratory Furnisher.
1886. Jackson, John, 98, Dobbie's Loan, Glasgow, Lubricant Manufacturer.
1901. Jackson, Percy G., c/o National Boiler Insurance Co., St. Mary's Parsonage, Manchester, Chemist.
1914. Jackson, Robert E., Tyneholme, Dartford, Kent, Works Chemist.
1890. Jackson, Saml., c/o L. H. Horsfall, Buckingham Mills, Perambore Barracks, Madras, N., India, Analytical Chemist.
1902. Jackson, Samuel, c/o Wm. Metcalf, Ltd., Church near Accrington, Director (Tar Distillery).
1898. Jackson, Thos., 31, Brownsville Road, Heaton Moor, near Stockport, Chemical Manufacturer.
1900. Jackson, Victor G., 17, Doughty Street, London, W.C., Chemist.
1900. Jackson, Dr. W. Hatchett, Radcliffe Library, Oxford, Librarian and Science Tutor (Keble College).
1893. Jackson, Rt. Hon. W. L., F.R.S. *See* Allerton, Rt. Hon. Lord.
1899. Jackson, W. Morton, c/o British Oxygen Co., Ltd., Great Marlborough Street, Manchester. Manager.
O.M. Jackson, W. P., Saxilby, near Lincoln, Chemical Works Manager.
1915. Jacobs, Lionel L., The Dominion Tar and Chemical Co., Box 445, Sault Ste. Marie, Ontario, Canada, Works Manager.
1900. Jacoby, Areli H., c/o American Dyewood Co., 80, Maiden Lane, New York City, U.S.A., Chemist.
1900. Jäger, B. M., c/o Geo. Jäger and Sons, 77, Burlington Street, Liverpool, Sugar Chemist.
1886. Jago, Wm., 17, Wilbury Avenue, Hove, Sussex, Barrister-at-Law.
1883. James, E. T., British Alizarin Co., Ltd., Silvertown, Victoria Docks, E., Secretary.
1915. James, Hugh W., South Metropolitan Gas Co., Tar Works, Ordnance Wharf, East Greenwich, S.E., Technical Chemist.

1905. James, Oscar S., 227, George Street, Toronto, Canada, Analytical Chemist.
1914. Jaques, John, 66, Grove Road, Wanstead, N.E., Rubber Technologist.
1890. Jarmain, Geo. S., Dalton Lodge, Huddersfied, Wool Extractor.
O.M. Jarmay, G., Hartford Lodge, Hartford, Cheshire, Alkali Manufacturer.
1911. Jarrom, Harry G., 14, Goodwyn Avenue, Mill Hill, Middlesex, Managing Director (Gallenkamp and Co.).
1900. Jarvie, Jas., Ferndale, Kenmure Avenue, Bishopbriggs, Scotland, Chemist.
1914. Jaubert, Dr. Geo. F., 155, Boulevard Malesherbes, Paris, France, Technical Journalist.
1910. Jayne, David W., c/o Barrett Manufacturing Co., Frankford, Philadelphia, Pa., U.S.A., Manager.
1913. Jeans, Harold, 165, Strand, London, W.C. Metallurgist.
1892. Jenkin, W. A., 12, Bella Vista, Minas de Rio Tinto, Provincia de Huelva, Spain, Metallurgical Chemist.
1905. Jenkins, Chas. D., 1368, Commonwealth Avenue, Allston, Mass., U.S.A., Chemist.
1894. Jenkins, John H. B., Laboratory, G.E.R. Works, Stratford, E., Analytical Chemist.
1912. Jenkins, Leslie C. W., 26, Ulundi Road, Blackheath, S.E., Chemist (Wood Dycing).
1912. Jenkins, Rees, 124, Foleshill Road, Little Heath, Coventry, Analytical Chemist.
1894. Jenks, Robt. L., 1, Charnock Place, Calcutta, India, Chemist.
1905. Jennison, Jas., Mountfield, London Road, Greenhithe, Kent, Chemist.
1904. Jepson, John Elliott, c/o Star Paper Mill Co., Ltd., Feniscowles, near Blackburn, Chemist.
1899. Jerdan, Dr. David S., Temora, Colinton, Midlothian, Chemist (Gelatin Works).
1899. Jessop, Louis V., Holmlea, 23, Woodville Road, Leytonstone, Essex, Chemist.
1904. Jewson, F. T., Earith, near St. Ives, Hunts, Chemist.
1896. Job, Robt., 649, Roslyn Avenue, Westmount, Quebec, Canada, Analytical Chemist.
1886. Johnson, A. E., 24, Parkdale, Wolverhampton, Analytical Chemist.
1908. Johnson, Arthur, 25, Nursery Street, Pendleton, Manchester, Chemist.
1904. Johnson, Cedric, Winnington Park, Northwich, Cheshire, Chemical Engineer.
1891. Johnson, Edmond E., c/o Adcocks, Drayton Park Works, Highbury, N., Chemical Engineer.
1904. Johnson, Dr. F. M. G., 286, Peel Street, Montreal, Canada, Chemist.
1904. Johnson, G. B., 7, Church Street, Liverpool, Wholesale Chemist.
1907. Johnson, H. Finnis, c/o Borax Consolidated, Ltd., 16, Eastcheap, London, E.C., Sales Manager.
1900. Johnson, John, c/o John Johnson and Co., 37th Street and Second Avenue, Brooklyn, N.Y., U.S.A., Chemical Engineer.
1913. Johnson, J. Carroll, 9, Well Road, Hampstead, N.W., Chemist.
O.M. Johnson, J. E. J., 133, Earlham Grove, Forest Gate, E., Manufacturing Chemist.
1900. Johnson, Jno. W. Haigh, West Riding Rivers Board, Wakefield, Yorks, Chemist.
1906. Johnson, Oliver L., c/o The Aspinook Co., Jewett City, Conn., U.S.A., Dye Works Manager.
1904. Johnson, S. Hearon, 7, Church Street, Liverpool, Wholesale Chemist.
1895. Johnston, Alex. R., 18, Percy Street, Ibrox, Glasgow, Analytical Chemist.
1906. Johnston, A. McA., Box 108, Germiston, Transvaal, Metallurgical Chemist.
1894. Johnston, G. Lawson. *See* Lawson-Johnston, G.
1904. Johnston, J. H., 8, Leopold Road, Wimbledon, S.W., Chemist and Bacteriologist.
1904. Johnston, Thos. J., 12, Garrioch Drive, Maryhill,
1890. Johnston, Wm. A., The S. S. White Dental Manufacturing Co., Prince Bay, N.Y., U.S.A., Dental Enamel Manufacturer.
1894. Johnston, W. E. Lawson. *See* Lawson-Johnston, W.E.
O.M. Johnston, Wm. G., Anchor Chemical Works, 1005, Garngad Road, Glasgow, Technical Chemist.
1910. Johnstone, E. J., Factory Square, Watertown, N.Y., U.S.A., Consulting Engineer and Industrial Chemist.
O.M. Johnstone, Jas., Shawfield Works, Rutherglen, Glasgow, Technical Chemist.
1905. Johnstone, J. Swanston, Natal Distilleries Co., Bond Street, Durhan, Natal, Distiller.
1903. Johnstone, S. J., 15, Springfield Road, New Southgate, N., Research Chemist.
1907. Jolliffe, Ernest H., Central Technical School, Toronto, Canada, Works Chemist.
1905. Jolliffe, Frank, 80, Shell Road, Lewisham, S.E., Chemist.
1904. Jones, Arthur B., 981, Central Avenue, Plainfield, N.J., U.S.A., Superintendent.
1912. Jones, B. Vaughan, P.O. Box 27, Petersburg, Va., U.S.A., Chemist and Manufacturer.
1912. Jones, Charles, 23, Bristol Road, Sheffield, Coke Plant Manager.
1908. Jones, D. Trevor, "Mountain Ash," Ravenglass, Cumberland, Works Chemist.
1911. Jones, Edgar D., 3, Neville Road, Waterloo, near Liverpool, Analytical Chemist.
1912. Jones, E. Gabriel, City Analyst's Laboratories, Ashton Street, Liverpool, Assistant Public Analyst for Liverpool.
1910. Jones, E. Protheroe, The Golden Horseshoe Estates Co., Salisbury House, London Wall, London, E.C., Secretary.
1902. Jones, E. Strangways, Sulphide Corporation, Ltd., Cockle Creek, N.S.W., Australia, Metallurgical Chemist.
1909. Jones, E. Willis, 22, Coleshill Terrace, Llanelly, South Wales, Chemical Manufacturer.
O.M. Jones, E. W. T., 10, Victoria Street, Wolverhampton, Analytical Chemist.
1897. Jones, Fred. W., 35, Addiscombe Road, Croydon, Technical Chemist.
1896. Jones, G. Cecil, 41, London Road, Forest Hill, S.E., Consulting Chemist.
1912. Jones, G. P., Cameron Powder Manufacturing Co., Emporium, Pa., U.S.A., General Manager.
1905. Jones, Harold, Morro Velho, Villa Nova de Lima, Minas Geraes, Brazil, Analyst and Assayer.
1893. Jones, Herbert. *See* Sefton-Jones, H.
1901. Jones, Herbert J., 40, Reginald Road, Forest Gate, E., Chemist.
1910. Jones, Ivor R., 54, Atlantic Chambers, Manchester, Chemical Merchant.
1905. Jones, J. E. Stacey, Hearsall Works, Coventry, Consulting Chemist and Technical Metallurgist.
1904. Jones, J. Shirley, Moscow, Idaho, U.S.A., Chemist.
1894. Jones, M. W., Stoneheck, Brislington, Bristol, Manager (Oil and Colour Works).
O.M. Jones, Walter Norris, Lancashire Metal Works, Widnes, Technical Chemist.
1903. Jones, Wm. App, c/o Boston Artificial Leather Co., 200, Fifth Avenue, New York City, U.S.A., Chemist.
1905. Jones, W. Ellis, 80, Arundel Avenue, Liverpool, Sugar Refiner.
1908. Joselin, Percy H., 81, Bennerley Road, New Wandsworth, S.W., Chemist.
1905. Joseph, A. F., Ceylon Technical College, Colombo, Ceylon, Lecturer on Chemistry.
1900. Josephson, Edgar, c/o Pantasote Leather Co., Passaic, N.J, U.S.A.
1891. Joslin, Omar T., 3223, Spring Grove Avenue, Cincinnati, Ohio, U.S.A., Chemical Engineer.
1887. Joüet, Dr. C. H., 238, East 2nd Avenue, Roselle, N.J., U.S.A., Technical Chemist.
1904. Jowett, Dr. H. A. D., Phœnix Mills, Dartford, Kent, Research Chemist.

1903. Joyce, Clarence M., c/o Dr. J. M. Matthews, 50 East 41st Street, New York City, U.S.A., Consulting Chemist (Nitrocellulose).
O.M. Justice, Philip M., 55–56, Chancery Lane, London, W.C., Patent Agent.

## K

1896. Kalbfleisch, Franklin H., 31, Union Square West, New York City, U.S.A., Chemical Manufacturer.
1908. Kaliski, Dr. Maximilian S., 17, Battery Place, New York City, U.S.A., Technical Chemist.
1884. Kalle, Dr. Wm., Biebrich-am-Rhein, Germany, Colour Manufacturer.
1913. Kastle, Dr. Joseph H., Kentucky Agricultural Experiment Station, Lexington, Ky., U.S.A., Director.
1901. Kauder, Dr. E. c/o Merck and Co., Rahway, N.J., U.S.A., Chemist.
1903. Kauffman, Milton H., American Smelting and Refining Co., Durango, Colo., U.S.A., Chemist.
1910. Kaufmann, George von, 2, Rondell Neu-Wittelshach, München, Bavaria, and (Jnls.) Christ's College, Cambridge, Director (Austrian Petroleum Co.).
1892. Kaufmann, Dr. Herbert M., c/o Mutual Chemical Co., Jersey City, N.J., U.S.A., Chemist.
1904. Kaus, Dr. Emil, c/o Roessler and Hasslacher Chemical Co., Perth Amboy, N.J., U.S.A., Chemist.
1915. Kawakami, Kaichi, 23, Fellows Road, Hampstead, N.W., Chemical Engineer.
1885. Kawakita, Prof. Michitada, Imperial Engineering College, Tokio, Japan, Professor of Applied Chemistry.
1912. Kay, Jas. H., Fair Fields, Dundee Lane, Ramsbottom, Lancashire, Soap Manufacturer.
O.M. Kay, Wm. E., 349, The Cliff, Broughton Park, Manchester, Printworks Chemist.
1910. Kaye, Henry R., c/o Cuming, Smith, and Co., Port Melbourne, Vic., Australia, Analytical Chemist,
1904. Kaye, Thos., 26, Rose Crescent, Perth, Scotland. Analytical Chemist.
1884. Keane, Dr. Chas. A., Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C., Principal.
O.M. Kearns, H. W., Boothroyd, Brooklands, near Manchester, Dyer.
1897. Kearns, Jno. S., Cowpe Mills, Waterfoot, near Manchester, Chemist and Dyer.
1894. Kehler, Lyman F., 1322, Park Road, Washington, D.C., U.S.A., Chief of Drug Laboratory, Department of Agriculture.
1910. Keeler, Warren I., 441, Arch Street, New Britain, Conn., U.S.A., Analytical Chemist.
1911. Keenan, Thomas J., 117, East 24th Street, New York City, U.S.A., Paper Chemist.
1915. Keetland, C. G., c/o The Standard Chemical Iron and Lumber Co., 524, St. Ambroise Street, Montreal, Canada, Montreal Manager.
1908. Keith, Jas. W., c/o H. D. Pochin and Co., Ltd., Bank Quay, Warrington, Analytical Chemist.
1907. Keller, Dr. Edward, P.O. Box 363, Perth Amboy, N.J., U.S.A., Chemist and Metallurgist.
1905. Keller, Roht. J., 89, Barclay Street, New York City, U.S.A., Dyestuff and Chemical Merchant.
1885. Kellner, Dr. Wm., 135, Victoria Road, Old Charlton, S.E., Chemist to War Department.
1908. Kellogg, H. W., c/o National Electrolytic Co., Niagara Falls, N.Y., U.S.A., General Manager.
1910. Kemmerich, Dr. Wm. E., c/o The Bayer Co., 117, Hudson Street, New York City, U.S.A., Chemist.
1907. Kendall, G. F., Chemical Works, Stratford-on-Avon, Chemical Manufacturer.
1912. Kennedy, Carl D., c/o General Rubber Co., Kisaran Asahan, Sumatra, D.E.I., Chemist.
1912. Kent, Raymond W., East Palistine, Ohio, U.S.A., Chemist.
1914. Kenyon, James, Kagura-Cho, Fukai-Mura, Hiogo-Ken, Japan, Analytical Chemist.
1903. Kenyon, Percy S., Park House, Cheadle Hulme, Cheshire, Drysalter.
1889. Kenyon, Thos., The Shrubbery, Hilton Park, Prestwich, near Manchester, Manufacturing Chemist.
1899. Kern, Walter P., 266, Paulison Avenue, and (Journals) c/o General Chemical Co., Dundee Works, Passaic, N.J., U.S.A., Chemist.
1906. Kerr, Charles H., c/o Pittsburg Plate Glass Co., Tarentum, Pa., U.S.A., Ceramic Research Chemist.
1912. Kerr, R. Vaughan, Fabrica de Aceites y Jaboneria Inglesa, Mislata, Valencia, Spain, Technical Chemist.
1890. Kerr, Saml. T., 516, North Delaware Avenue, Philadelphia, Pa., U.S.A., Salt Manufacturer.
1897. Kerr, Wm. M., 712, La Fayette Building, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1896. Kershaw, Jno. B. C., West Lancashire Laboratory, Waterloo, Liverpool, Analytical Chemist.
1909. Kesava-Menon, A., Chittur-Palghat, South Malahar, Madras, India, Chemist.
1902. Kessler, Henry W., 720, Electric Building, Cleveland, Ohio, U.S.A., Manufacturing Chemist,
1893. Kestner, Paul, 37, Parliament Street, Westminster, S.W., Chemist.
1900. Kewley, Jas., c/o Anglo-Egyptian Oilfields, Ltd., Suez, Refinery Manager.
1890. Keys, W. H., Hall End Works, West Bromwich, Oil and Chemical Manufacturer.
1900. Kilgore, Benj. W., Raleigh, N.C., U.S.A., Chemist.
1901. Kilmer, Fred. B., c/o Messrs. Johnson and Johnson, New Brunswick, N.J., U.S.A., Chemical Manufacturer.
O.M. Kinch, E., Royal Agricultural College, Cirencester, Professor of Chemistry.
1912. Kind, Georg E., 33, King Street, Covent Garden, London, W.C., Bookseller and Publisher.
O.M. King, A. J., Elleray, Windermere, Bleacher and Finisher.
1907. King, C. A., c/o The Farnley Iron Co., Farnley, near Leeds, Technical Chemist.
1913. King, Edward W., New Liverpool Rubber Works, Walton, Liverpool, Analytical Chemist.
1905. King, Frank E., 75, Gracechurch Street, London, E.C., Analytical Chemist.
1911. King, Harold, 24, The Brent, Dartford, Kent, Chemist.
O.M. King, J. Falconer, 43, Stirling Road, Edinburgh, Consulting Chemist.
1910. King, John, Summerville Gardens, Latchford, Warrington, Lancashire, Works Manager.
1913. King, Dr. Robert C., Aptekarsky Prospect 8a, Petrograd, Russia, Chemist.
1895. King, Sidney J., Brean, Upton Road, Bexley Heath, Kent, Analytical Chemist.
O.M. King, Walter R., 16, Mincing Lane, London, E.C.; and (Journals) Torville, The Cliffs, Southend-on-Sea, Chemical Manufacturer.
1905. King, Warren C., 72, Front Street, New York City, U.S.A., President, Independent Chemical Co.
1896. Kingdon, Holman, c/o Joseph Crosfield and Sons, Warrington, Technical Chemist.
1908. Kingsbury, Percy C., German-American Stoneware Works, 50, Church Street, New York City, U.S.A., Chief Civil Engineer.
1883. Kingsford, T. P., Oswego, N.Y., U.S.A., Starch Manufacturer.
O.M. Kingzett, C. T., "Maplin," Frinton on Sea, Essex, and (Journals) Sanitas Co., Ltd., Locksley Street, Limehouse, E., Chemical Manufacturer.
1906. Kinnersley, H. W., Branscombe, Merry Hill Road, Bushey, Herts, Chemist and Manufacturer.
1897. Kipping, Dr. F. Stanley, F.R.S., University College Nottingham, Prof. of Chemistry.
1914. Kirby, William, 50, Mayhill Road, Charlton, Kent, Chemist.
1908. Kirkhope, T. Bertram, Sandbank, Gwithian, Hayle, Cornwall, Explosives Works Chemist.
1905. Kirkland, John, 105, Holmdene Avenue, Herne Hill, S.E., Technical Instructor.

1900. Kirkpatrick, Prof. Stafford F., 84, Gore Street, Kingston, Ont., Canada, Professor of Metallurgy.
1913. Kirsebom, Gustave, Braden Copper Co., Molino, Rancagua, Chile, Metallurgical Engineer.
1911. Kirstein, H. C., 7, Gracechurch Street, London, E.C., Consulting Engineer.
1902. Kitchen, Wm. J., Port Melbourne North, Vic., Australia, Soap and Candle Manufacturer.
1883. Kitto, B., 26, Lancaster Road, Finsbury Park, London, N., Analytical Chemist.
1900. Kittredge, H. G., c/o The Kay and Ess Co., Dayton, Ohio, U.S.A., Chemist.
1908. Klaber, Wm., c/o Castle Kid Co., Camden, N.J., U.S.A., Chemist.
1900. Kleber, Dr. Clemens, Clifton Chemical Laboratory, Passaic, N.J., U.S.A., Director.
1911. Klein, C. A., 4, Brimsdown Avenue, Enfield Highway, Middlesex, Works Chemist.
1909. Klemm, Wilfred E., 25, Marmion Road, Liverpool, Chemist.
1908. Klien, Dr. J. L., 7, King Street, Cheapside, London, E.C., Works Manager.
1903. Kline, Clarence M., 429, Arch Street, Philadelphia Pa., U.S.A.. Wholesale Druggist.
1889. Klipstein, A., Messrs. A. Klipstein and Co., 644—654, Greenwich Street, New York City, U.S.A., Chemical Manufacturer.
1902. Klipstein, Ernest C., 93, Prospect Street, East Orange, N.J., U.S.A., Chemical Merchant.
1913. Klotz, W. C., Canadian Ammonia Co., Ltd., Toronto, Canada, Chemist.
1891. Knaggs, Alfred B., c/o Dr. Knaggs, Oak House, New North Road, Huddersfield, Technical Chemist in Dyeworks.
1911. Knapp, Harry P., c/o Talbot Dyewood and Chemical Co., 38-44, Middle Street, Lowell, Mass., U.S.A., Chemical Manufacturer.
1911. Knapp, Harry P., Chemical Manufacturer.
1892. Knecht, Dr. E., Beech Mount, Marple, Cheshire, Professor of Tinctorial Chemistry.
1904. Kniffen, Frederick, 823, North Franklin Street, Wilmington, Del., U.S.A., Chemist.
1887. Knight, A. H., 51, Highfield Street, Liverpool, Assayer.
1903. Knight, Harley F., 14, Old Queen Street, Westminster, S.W., Analyst.
O.M. Knight, J. Baillie, Soap Manufacturer.
1887. Knights, J. West, 67, Tenison Road, Cambridge, Analytical Chemist.
1885. Knipler, F., "Strathberg," Greensborough, near Melbourne, Victoria, Starch Manufacturer.
1907. Knoedler, E. L., c/o Welsbach Co., Gloucester City, N.J., U.S.A., Factory Foreman.
1910. Knott, E. Anthony F., The Priestman Collieries, Ltd., Ottovale Coke Works, Blaydon-on-Tyne, Works Chemist.
1911. Knowland, Daniel P., 89, Barclay Street, New York City, U.S.A., Chemist.
1904. Knowles, W. R., The Hollies, Wood Green, Wednesbury, Chemical Works Manager.
1886. Knox, E. W., Colonial Sugar Refining Co., Sydney, N.S.W.; and (subs.) c/o Parhury, Henty, and Co., 20, Eastcheap, London, E.C., Sugar Manufacturer and Refiner.
1906. Knudsen, Kristian Hv., 96, Maiden Lane, New York City, U.S.A., Chemist.
1905. Koch, Dr. Geo. W., 905, Willoughby Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1904. Koch, J. A., Bluff and Pride Streets, Pittsburg, Pa., U.S.A., Chemist.
1911. Kochs, A. Victor, 301, Glossop Road, Sheffield, Gas Engineer.
1904. Koebig, Dr. J., Suite 1026, Union Oil Building, Los Angeles, Cal., U.S.A., Consulting Chemical Engineer.
1909. Koekkoek, Patrick R., c/o J. W. and T. A. Smith, Ltd., Imperial Colour Works, 249, Old Ford Road, London, E., Works Chemist.
1911. Koelle, Dr. G., Metallbank und Metallurgische Gesellschaft, Bockenheimer Anlage 45, Frankfurt a/M., Germany, Chemist.
1884. Kohn, Dr. Charles A. *See* Keane, Dr. Chas. A.
1902. Kohnstamm, Lothair S., 87, Park Place, New York City, U.S.A., Chemist.
1913. Kondo, K., 136, Yoyogi, Tokyo, Japan, Chemical Engineer.
O.M. Kraftmeier, E., Bank Buildings, St. James's Street, London, S.W., Explosives Manufacturer.
1906. Krais, Dr. Paul, Lustnauer Allee, Tuebingen, Germany, Chemist.
1894. Krause, Dr. Albert H., 1444, West 98th Street, Cleveland, Ohio, U.S.A., Chemist (Grasselli Chemical Co.).
O.M. Krause, Prof. Dr. G., Cöthen (Anhalt), Germany, Chemist.
1898. Krebs, H. J., 806, Franklin Street, Wilmington, Del., U.S.A., Manufacturing Chemist.
1908. Kress, Otto, 438, West 116th Street, New York City, U.S.A., Teacher of Science.
1900. Kunheim, Dr. Erich, Jnls. to c/o C. Hilt, Worlands Wharf, Wharf Street, Canning Town, E., Chemist.
1904. Kunz, Dr. George F., c/o Tiffany and Co., 409, 5th Avenue, New York City, U.S.A., Gem Expert.
1905. Kurt, Franklin T., 553, Boylston Street, Boston, Mass., U.S.A., Professor of Chemistry, B.Y.M.C.A.
1907. Kutsch, Dr. Wm. A., c/o Corn Products Manufacturing Co., Pekin, Ill., U.S.A., Chemist.
1900. Kuttroff, Fred., 128, Duane Street, New York City, U.S.A., Merchant.
1909. Kwoh, See Kwain, Municipal Technical College, Mukden, Manchuria, China, Chemical Engineer.
O.M. Kynaston, J. W., 3, Oak Terrace, Beech Street, Liverpool, Chemical Engineer.
1907. Kynaston, Wm. C. R., 9, Harland Road, Higher Tranmere, Birkenhead, Analyst.

## L

1906. Lacell, Harold G., Ardoch, Nether Street, Finchley, N., Chemist.
1890. Lacey, E. C., St. Julian's Lodge, St. Julian's Farm Road, West Norwood, Manufacturing Chemist.
1903. Lachman, Dr. Arthur, 1926 Lake Street, San Francisco, Cal., U.S.A., Chemical Engineer.
1913. Laib, Walter, Rittman, Wayne Co., Ohio, U.S.A., Chemist (Ohio Salt Co.).
O.M. Laidler, C. P., 20, Noble Terrace, Gateshead-on-Tyne, Analytical Chemist.
O.M. Lake, G., jun., Lee Mount, Glossop, Derbyshire, Analytical Chemist.
1907. Lake, Henry B., c/o Kemball, Bishop and Co., Three Mills Lane, Bromley-by-Bow, E., Works Manager.
1900. Lamar, Wm. R., 327, North 18th Street, East Orange, N.J., U.S.A., Chemical Manufacturer.
1898. Lamb, Morris Chas., Leathersellers' Technical College, 176, Tower Bridge Road, London, S.E., Chemist.
1912. Lancaster, Harry C., 39, Ladbroke Grove, Kensington, W., Managing Director.
1907. Lancaster, Harry M., Laboratory, Provincial Board of Health, 5, Queen's Park, Toronto, Canada, Chemist.
1914. Lander, Dr. G. D., Royal Veterinary College, Camden Town, London, N.W., Consulting Chemist.
1910. Landrum, R. D., c/o The Harshaw, Fuller and Goodwin Co., Electric Building, Cleveland, Ohio, U.S.A., Chemical Engineer.
1904. Lane, C. Cyril P., Chemist.
1910. Lane, J. Henry, 3, Arbour Square, Stepney, London, E., Chemist.
1903. Lane, Nathaniel J., U.S. Laboratory, 641, Washington Street, New York City, U.S.A., Chemist.
1893. Lang, Dr. Wm. R., University of Toronto, Canada, Professor of Chemistry.

1892. Langer, Dr. Carl, Ynyspenllwch, Clydach, R.S.O., Glamorganshire, Analytical Chemist.
1914. Langlands, S. H. B., Glasgow Corporation Lighting Dept., 20, Trongate, Glasgow, Chief Inspector of Lighting.
1897. Langmuir, Arthur C., c/o Marx and Rawolle, 9, Van Brunt Street, Brooklyn, N.Y., U.S.A., Factory Manager.
1902. Langmuir, F. Leighton, 350, Bloor Street West, Toronto, Canada, Chemist.
1898. Langstaff, Wm., 39, Orchard Street, Elizaheth, N.J., U.S.A., Chemist.
1900. Lant, Herbert, "Ivy Bank," Wath-on-Dearne, near Rotherham, Yorks, Chemist and Manager.
1909. Lantsherry, Fred. C. A. H., Birmingham Small Arms Co., and (Journal) 63, Walford Road, Sparkbrook, Birmingham, Metallurgical Chemist.
1914. Laplante-Courville, H., Laval Dental School, Montreal, Canada, Lecturer.
1903. Larter, Alfred T., 5, Rookfield Avenue, Muswell Hill, N., Chemist.
1904. Lasher, F. G., 251, Bush Street, Brooklyn, N.Y., U.S.A., Chemist.
1884. Latham, Baldwin, Parliament Mansions, Victoria Street, Westminster, S.W., Civil Engineer.
1889. Latham, J. J., Mill House, Bold, Widnes, Chemical Works Manager.
1907. Lathwood, Arthur, c/o Borax Consolidated, Ltd., 16, Eastcheap, London, E.C., and (Jnls.) The Briars, Maidstone Road, Bounds Green, N., Chemist.
1914. Lauder, Dr. Alex., College of Agriculture, 13, George Square, Edinburgh, Lecturer in Chemistry.
1914. Laurie, Dr. A. P., Heriot Watt College, Chambers Street, Edinburgh, Principal.
1909. Law, Douglas J., 9, Scely Road, Lenton Sands, Nottingham, Chemist.
1913. Law, John A., c/o Barry, Ostlere, and Shepherd, Ltd., Forth Works, Kirkcaldy, Scotland, Linoleum Works Director.
1907. La Wall, Chas. H. 39, South 10th Street, Philadelphia, Pa., U.S.A., Analytical Chemist.
O.M. Lawrence, Jas., c/o Dr. T. P. Grant, Montraive, Blantyre, Scotland, Explosives Manufacturer.
1911. Lawrence, Wm. A., Laboratory, 11, Vandewater Street, New York City, U.S.A., Director.
1904. Lawson, Jos. H. S., Rodney Street Works, Oldham Road, Manchester. Salesman.
1894. Lawson-Johnston, G., (Journals) 29, Portman Square, W., and 1, King's Arms Yard, London, E.C., Chairman of Bovril, Ltd.
1894. Lawson-Johnston, W. E., c/o Bovril, Ltd., 152, Old Street, London, E.C., Director.
1907. Leach, Dr. F. P., Briarswood, Chester Road, Erdington, Birmingham, Research Chemist.
1908. Leake, Percy C., Deanbank Terrace, Ferryhill Village, Co. Durham, Tar Works Manager.
1898. Lean, Geo., 3, Park Quadrant, Glasgow, Chemist.
O.M. Leather, J. Walter, Agricultural Research Institute, Pusa, Behar and Orissa, India, Government Chemist.
1913. Lehach, Dr. Hans, c/o The Bakelite Co., Ltd., Orh Works, Cowley, near Uxbridge, Middlesex, Chief Chemist.
1893. Le Boutillier, Clement, o/o Taylor Iron and Steel Co., High Bridge, N.J., U.S.A., Chemist.
1907. Lecco, Prof. Marco T., Vasina 15, Belgrade, Serbia, Professor of Chemistry.
1904. Le Chatelier, Prof. H., 75, Rne Notre Dame des Champs, Paris, France, Professor (l'Ecole des Mines).
1896. Lecomber, W. G., Cambridge Works, Knott Mill, Manchester, Engineer.
1896. Lederle, Dr. E. J., 39, West 38th Street, New York City, U.S.A. Chemist.
1892. Ledoff, Prof. A., Technological Institute, Kharkoff, Russia, Professor of Chemistry.
1895. Ledoux, Dr. Albert R., 99, John Street, New York City, U.S.A., Chemist.
1903. Ledoux, Ang. D., 15, William Street, New York City, U.S.A., Importer of Pyrites.
1915. Ledwidge, Jos. G., Municipal Technical School, Drogheda, Ireland, Analytical Chemist.
1905. Lee, Ashton, Lawrence, Mass., U.S.A., Manufacturing Chemist.
1905. Lee, Frank W., Lawrence, Mass., U.S.A., Manufacturing Chemist.
1905. Lee, John C., Wellesley, Mass., U.S.A., Assistant Engineer (American Telegraph and Telephone Co.).
1898. Lee, Jno. L., Woodfield, Lytham, Lancashire, Dyer and Bleacher.
1885. Lee, S. Wright, 6-10, Whitechapel, Liverpool, Wholesale Druggist.
1906. Lee, William, 28, Sherard Gardens, Eltham, Kent, Works Chemist.
1912. Lees, Arnold, "Hazelhurst," Town Street, Beeston, Leeds, Analytical Chemist.
1901. Leffler, Rudolf L., c/o Thos. Firth and Sons, Ltd. Norfolk Works, Sheffield, Metallurgical Chemist.
1914. Legg, Bertram, Greenheys, Murray Rd., Northwood, Middlesex; Jnls. to 61—62, Chancery Lane, London, W.C., Chemist and Assayer.
1907. Lehmann, Dr. Adolf, University of Alberta, Strathcona, Alberta, Canada, Professor of Chemistry.
1888. Leigh, Cecil, Birmingham Metal and Munition Co., Adderley Park Rolling Mills, Birmingham, Technical Chemist.
1902. Leighton, A. E., Commonwealth Cordite Factory, Maribyrnong, Victoria, Australia, Analytical Chemist.
1894. Leitch, Jno. W., Milnsbridge Chemical Works, near Huddersfield, Aniline Dye Manufacturer.
1904. Le Maistre, Fred J., Room 781, Du Pont Building, Wilmington, Del., U.S.A., Research Chemist.
1898. Leman, Wm. T., P.O. Box 747, Chicago, Ill., U.S.A., Oil and Asphalt Agent.
1883. Lennard, F., c/o Forbes Abbott, and Lennard, Ltd., Chemical Works, Shoreham, Sussex, Chemical Manufacturer.
1884. Leonard, Wm. J., 1, Lindfield Gardens, Hampstead, N.W., Naphtha Distiller.
1888. Lequin, E., Directeur Général des Usines de Produits Chimiques de la Société de St. Gobain, 1, Place des Saussaies, Paris (VIII^e.), France.
1904. Lesley, R. W., 604, Pennsylvania Building, Philadelphia, Pa., U.S.A., Cement Manufacturer.
1907 Leslie, Dr. Fred. A., College of Pharmacy, 115, West 68th Street, New York City, U.S.A., Chemist.
1904. Lessing, Dr. Rudolf, Southampton House, 317, High Holborn, London, W.C., Consulting Chemist.
1912. Lessner, C. B., Carril, Spain, Metallurgical Chemist.
1892. Lester, J. H., Grange Drive, Monton Green, Eccles, Lancs, Analytical Chemist.
1899. Le Sueur, Dr. Henry R., Chemical Laboratory, St. Thomas' Hospital, London, S.E., Demonstrator.
1891. Lever, Sir Wm. H., Bart., Thornton House, Thornton Hough, Cheshire, Soap Manufacturer.
1909. Lever, W. Hulme, Heathfield, Bebington, Cheshire, Soap Manufacturer.
1901. Levett, Walter, Holmlands, Stanford-le-Hope; and (Journals) Mines Safety Explosives Co., Stanford-le-Hope, Essex, Factory Manager.
1903 Levi, Dr. Louis E., 781, Sherman Boulevard, Milwaukee, Wis., U.S.A., Chemist.
1912. Levin, Isaac H., 95, Weeguahic Avenue, Newark, N.J., U.S.A., Chemist.
1906. Levinstein, Edgar, 74, India Street, Boston, Mass., U.S.A., Chemical Manufacturer.
1901. Levinstein, Dr. Herbert, c/o Levinstein, Ltd., Blackley, near Manchester, Chemist.
O.M. Levinstein, Ivan, Hawkesmoor, Fallowfield, Manchester, Colour Manufacturer.
1903. Levy, Arthur G., 1927, Madison Avenue, New York City, U.S.A., Chemist.
1909. Levy, Louis S., 80, Maiden Lane, New York City, U.S.A., Editor "American Perfumer."

1901. Levy-Mond, Dr. Albert. *See* Mond, Dr. Albert L.
1887. Lewes, Prof. Vivian B., Royal Naval College, Greenwich, S.E., Professor of Chemistry.
1898. Lewin, H. James, Royal Clarence Yard, Gosport, Hants, Analytical Chemist.
1914. Lewis, C. Preston, 223, Brixton Hill, London, S.W., Technical Chemist.
1896. Lewis, Daniel C., c/o Millville Manufacturing Co., Millville, N.J., U.S.A., Dye Works Chemist.
1904. Lewis, Edw. W., c/o J. G. Ingram and Sons, London India Rubber Works, Hackney Wick, N.E., Chemist.
1900. Lewis, Ernest A., 310, Dudley Road, Birmingham, Chemist and Metallurgist.
1905. Lewis, F. W., Aetna Powder Co., 143, Dearborn Street, Chicago, Ill., U.S.A., Secretary.
1900. Lewis, John, 76, Underhill Road, Lordship Lane, S.E., Cashier (Paint Works).
1909. Lewis, Reginald J., Govt. Explosivee Office, 423, Flinders Lane, Melhourne, Australia, Chemist.
1900. Lewis, Dr. S. Judd, The Laboratories, Staple Inn Buildings, High Holborn, London, W.C., Analytical Chemist.
1914. Lewis, Prof. W. C. McC., Muspratt Laboratory, The University, Liverpool, Professor of Physical Chemistry.
1913. Lewkowitsch, Mrs. K. J., The Lewkowitech Laboratories, 71, Priory Road, West Hampstead, N.W.
1907. Leyson, Lewis T., c/o Standard Bank of South Africa, Johannesburg, Transvaal, Analytical Chemist.
1901. Lichtenstein, Alf. F., c/o Geiscnheimer and Co., P.O. Box 994, New York City, U.S.A., Chemist.
1913. Lichtenstein, L. M., Royal Albert and Victoria Docks Chemical Works, Silvertown, London, E., Manufacturing Chemist.
1904. Lichtenthaeler, Robt. A., Rhode Island Agricultural Experiment Station, P.O. Box 112, Kingston, R.I., U.S.A., Chemist.
1913. Lidholm, J. H., c/o Alby United Carbide Factories, Ltd., 308, Winchester House, Old Broad Street, London, E.C., Chemical Engineer.
O.M. Liebmann, Dr. A., The Whim, Weybridge, Surrey, Consulting Chemist.
1913. Lichreich, Dr. Erik, 30, Kronprinzen Ufer, Berlin, Germany, Chemist.
O.M. Lightfoot, T. E., Fernleigh, Accrington, Calico Printer's Chemist.
1905. Liley, Thos. A., 46, Westover Road, Bramley, Leeds, Chemist.
1898. Lilly, Josiah K., c/o Eli Lilly and Co., Indianapolis, Ind., U.S.A., Manufacturing Pharmacist.
1904. Lindemann, Ottocar, 53, Victoria Street, Westminster, S.W., Mauaging Director (Korting Bros., Ltd.)
1908. Lindfield, James H., c/o Messrs. Martineau, King Edward Street, Whitechapel, E., Technical Chemist.
1897. Lindsay, Robt., Transvaal G.M. Estates, Pilgrim's Rest, Lydenburg, Transvaal, Chemist.
1890. Ling, Arthur R., Laboratory, 74, Great Tower Street, London, E.C., Consulting Chemist.
1905. Lips, Dr. Carl H., 99, Hart Street, Brooklyn, N.Y., U.S.A., Chemist.
1896. Lishman, Geo. P., Lambton Coke Works, Fence Houses, Co. Durham, Colliery Chemist.
1905. Little, Arthur D., 93, Broad Street, Boston, Mass., U.S.A., Consulting Chemist.
O.M. Littlejohn, Jas., c/o Littlejohn and Whitby, P.O. Box 849, Johannesburg, Transvaal, Analytical Chemist.
1904. Livermore, W. D., Washington Mill, Lawrence, Mass., U.S.A., Chemist.
1886. Liversedge, A. J., 63, Northampton Road, Croydon, Mechanical Engineer.
1914. Liversedge, John A., May Morn Mills, Mangaron, near Wellington, New Zealand, Assistant Lead Mill Manager.
1904. Liverseege, J. F., Analytical Dept., 44, Broad Street, Birmingham, City Analyst.
O.M. Liversidge, Prof. A., F.R.S., Field Head, Coombe Warren, Kingston, Surrey, Professor of Chemistry.
1907. Liversidge, Bernard, 6, Nelson Street, Rotherham, Yorks, Analytical Chemist.
1883. Livingston, W. J., 30, Fountayne Road, Stoke Newington Common, London, N., Analytical Chemist.
1903. Llewellyn, Ivor P., 149, Moorland Road, Stockport, Chemist.
1907. Llewellyn, W. B., 114, Belgrave Road, New Moston, Manchester, Chemist.
1909. Lloyd, Edward, 27, Broomgrove Road, Sheffield, Chemical Engineer.
1913. Lloyd, Prof. Francis E., Dept. of Botany, McGill University, Montreal, Canada, Prof. of Botany.
1904. Lloyd, Leonard B., Broadford Tannery, Broadford, Victoria, Australia, Tanner.
1907. Lloyd, Dr. Lorenzo L., Technical College, Bradford, Yorks, Lecturer in Chemistry.
1909. Lobley, A. G., Mill Bank, Trefriw, North Wales, Chemist.
1914. Lockett, William T., 74, Victoria Road, Urmston, near Manchester, Research Chemist.
1888. Lodge, Edw., 35, Scale Hill, Cowcliffe, Huddersfield, Teacher of Wool Dyeing.
1891. Loewenthal, Dr. R., Uhlandstrasse 39, Frankfurt a/M., Germany, Lecturer on Dyeing.
1907. Lomax, E. Lawson, Mowbreck, Farington, near Preston, Chemist.
1901. Long, Eugene J., c/o E. O'Callaghan and Son, City Tannery, Limerick, Ireland, Tanner.
1909. Long, George, Cudahy, Wis., U.S.A., Glue Maker.
1898. Longstaff, Dr. Jas. P., Chemical Department, The University, Edinburgh, Assistant.
1908. Longwell, Alex., 404, Lumsden Building, Toronto, Canada, Mining Engineer.
1890. Lord, F. J., Winnarleigh, Southborne, Bournemouth, Hants, Analytical Chemist.
1896. Lord, Jno. Lloyd, Wellington Cement Works, Elton, Bury, Lancs, Chemist and Manager.
O.M. Lorenz, H., 7 and 8, Idol Lane, London, E.C., Chemical Merchant.
1904. Lorimer, John H., 280, West Walnut Lane, Germantown, Philadelphia, Pa., U.S.A., Textile Machinist and Mercerisor.
1905. Loring, Lindsley, 40, Central Street, Boston, Mass., U.S.A., Vice-President (Cochrane Chemical Co.).
1909. Lorleberg, C., c/o R. W. Greeff and Co., Thames House, Queen Street Place, London, E.C., Chemical Merchant.
O.M. Lorrain, Jas. G., Staple Inn Buildings, Holborn, London, E.C., Chartered Patent Agent.
1904. Lossen, Dr. Clemens F., Boulevardul Independentei 8, Ploesti, Roumania, Chemist.
O.M. Lott, F. E., The Laboratory, Bridge Chambers, Burton-on-Trent, Consulting Brewing Chemist.
O.M. Louis, D. A., 123, Pall Mall, London, S.W., Metallurgist and Mining Engineer.
1894. Louis, Prof. Henry, Armstrong College, Newcastle-on-Tyne, Professor of Mining.
O.M. Love, Dr. E. G., 124, East 15th Street, New York City, U.S.A., Analytical Chemist.
1899. Love, Wm., 28, Royal Exchange Square, Glasgow, Managing Director (Broxburn Oil Co., Ltd.).
O.M. Lovibond, T. W., West Jesmond House, Newcastle-on-Tyne, Brewer.
1913. Low, Frank S., c/o Cutler-Hammer Manufacturing Co., 144th Street and Southern Boulevard, New York City, U.S.A., Chemical Engineer.
1900. Low, Prof. Wilson H., Cudahy Packing Co., South Omaha, Neh., U.S.A., Chemist.
1911. Lowcock, J. Harold, 39, Wickham Way, Park Langley, Beckenham, Kent, Chemist.
1913. Lowe, Austin, 39, Chelverton Road, Putney, S.W., Research Chemist.
1887. Lowe, Clement W., Thorneyholme, Knutsford, Cheshire, Manufacturing Chemist.
O.M. Lowe, W. F., 18, Hough Green, Chester, Analytical Chemist.
1906. Lowson, Wm., The University, Leeds, Chemical Lecturer.
1895. Lucas, Alf., Laboratories, Public Works Ministry Gardens, Cairo, Egypt, Analyst.

1892. Lucas, Bernard R., Winnington Park, Northwich, Alkali Works Manager.
1914. Lucas, Wm. A., c/o Chila Exploration Co., Chuorcii Cajnata, via Antofagasta, Chile, Chemist.
O.M. Luck, A. Courtenay, San Martin 475, Buenos Aires, Argentina, Explosives Chemist.
1913. Lucy, Arthur J., c/o Angelo Bros. Ltd., Cossipore, Calcutta, India, Consulting Engineer.
1900. Lummus, Walter E., 39, Bassett Street, Lynn, Mass. U.S.A., Manager.
1903. Lumsden, Alex. A., Forth Chemical Works, Bo'ness, Scotland, Technical Chemist.
1910. Lumsden, William W., 39, Caledonia Road, Saltcoats, Scotland.
1888. Lund, Jas., 142, Hawthorne Street, Malden, Mass., U.S.A., Ammonia Works Manager.
1888. Lundholm, Carl O., 220, Winchester House, Old Broad Street, London, E.C., Explosives Works Manager.
1913. Lunge, Ernest, 2, Plowden Buildings, Temple, London, E.C., Barrister-at-Law.
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1885. Lupton, Sydney, 102, Park Street, Grosvenor Square, London, W.
1884. Lüthy, Otto, P.O. Box 63, Maywood, N.J., U.S.A., Analytical Chemist.
1903. Lye, Ernest B., Leagrave Hall, near Luton, Beds, Straw Plait Dyer and Bleacher.
1885. Lye, W. T., Leagrave Hall, near Luton, Beds, Straw Dyer.
1915. Lyle, C. E. Leonard, 21, Mincing Lane, London, E.C., Sugar Refiner.
1884. Lyle, James, Ardesco, West Silvertown, E., Sugar Refiner.
1896. Lymn, Arthur H., Sanctuary House, Tothill Street, Westminster, S.W., (Jnls.) to 53, Hampstead Way, Golders Green, N.W., Consulting Chemical and Gas Engineer.
1899. Lynn, R. Rankine, 7, Highburgh Terrace, Dowanhill, Glasgow. Chemical Engineer.
O.M. Lyon, J. G., The Aire Tar Works, Knottingley, Yorks, Tar Distiller.
1906. Lyons, Robert H., c/o Canadian Explosives, Ltd., Belœil Station, Quebec, Canada, Chemist.
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## M

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1887. Mabery, Prof. Chas. F., Case School of Applied Science, Cleveland, Ohio, U.S.A., Professor of Chemistry.
1891. Macadam, Herbert E., Dalkeith, Glengall Road, Woodford Green, Essex, Manure Works Manager.
1894. Macadam, Stevenson, 55, York Place, Edinburgh, Analytical Chemist.
1912. McAfee, Dr. A. M., c/o The Gulf Refining Co., Port Arthur, Texas, U.S.A., Chemist.
1894. McAlley, Robt., Bankside, Falkirk, Scotland, Paint Works Manager.
1892. Macara, Thos., jun., 20, Denton Road, Stroud Green, N., Chamist.
1912. McArly, T. P., Mount Lyell Mining and Railway Co., Queenstown, Tasmania, Chemist and Assayer.
1887. McArthur, James B., Price's Patent Candle Co., Limited, Belmont Works, Battersea, S.W., Chemist.
O.M. McArthur, J. S., 74, York Street, Glasgow, Consulting Chemist and Metallurgist.
1901. Macarthur, Jno. S., 15, St. John's Road, Pollokshields, Glasgow, Paint and Varnish Manufacturer.
1892. McArthur, Thos., 711, Tower Building, Water Street, Liverpool, Drysalter and Dyawood Extractor.
1912. Macaulay, J. W., The Laboratory, Holwell Iron Co., Ltd., Ashfordby, near Melton Mowbray, Northumberland, Metallurgical Chemist.
1911. McBride, K. R., Glens Falls, N.Y., U.S.A., Colour Chemist.
1898. MacCallum, D. A., 389, Central Chambers, 93, Hope Street, Glasgow, Chemist.
O.M. McCallum, J. M., Southdene, Paisley, Scotland, Soap Manufacturer.
1914. McCarthy, Robt. A., Bertram Street, Mortlake, Sydney, N.S.W., Australia, Gas Chemist.
1905. McCaw, Lt.-Col. W. D., Library, Surgeon General's Office, Washington, D.C., U.S.A., Officer, Medical Department, U.S. Army.
1905. McCleary, Wm., 61, Station Road, Pendlebury, near Manchester, Finisher.
1910. McColl, A. L., North Brazilian Sugar Factories, Ltd., Tiuma Recifa, Pernambuco, Brazil, Chemist.
1907. McConnan, Sergt. Jas., Chemist.
1914. McCormick, J. T., Laboratory Dept. of Defence, Melbourne, Australia, Chemist.
1903. McCourt, Cyril D., 45, Braxted Park, Streatham Common, S.W., Chemist.
1912. McCoy, James P. A., Research Division, Westinghouse Electric and Manufacturing Co., East Pittsburg, Pa., U.S.A., Analytical Chemist.
1913. McCrady, McH., 9, St. James' Street, Montreal, Canada, Chemist and Bacteriologist.
1897. McCrae, Dr. John, Government Laboratories, P.O. Box 1080, Johannesburg, Transvaal, Government Analyst.
1898. McCreath, Wm. D., Quantock Vale Cider Works, North Petherton, Bridgwater, Cidar Manufacturar.
1900. McCulloch, John, Glencoe, Lostock Gralain, near Northwich, Cheshire, Chemical Engineer.
1911. McCulloch, Norman G., Rhodes Works, Rhodes, Manchester, Chemist and Calico Printer.
1903. McCully, R. E. J., c/o Indian Cement Co., Norbandar, Kathiawar, India, and (Jnls.) 13, Lance Lane, Wavertree, Livarpool, Analytical Chemist.
1910. Macdonald, Alexander, Netherlea, Matilda Road, Pollokshields, Glasgow, Manufacturing Chemist.
1912. McDonald, Allan D., "Belgrano," Milngavie, near Glasgow, Manufacturing Chemist.
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1912. McDonald, Donald, 95, Clarence Gate Gardens, Regent's Park, London, N.W., Analytical Chemist.
1897. MacDonald, G. W., Whitefriars, Rochester, Kent, Chief Explosives Research Chemist (Curtis's and Harvey, Ltd.).
1910. Macdonald, J. L. A., 13, Howard Place, St. Andrews, Fife, Scotland.
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1906. Macdougald, Geo. D., 140, Perth Road, Dundee, City Analyst.
1890. McDougall, J. T., Dunolly, Morden Road, Blackheath, S.E., Manufacturing Chamist.
1906. McDowall, Wm., 42, Herriet Street, Pollokshields, Glasgow, Analytical Chemist.
1889. MacEwan, Peter, 64, Southwood Lane, Highgate, N., Editor of "Chemist and Druggist."
1901. McEwen, Duncan C., c/o Chosen Gold Mines, Ltd., Kok-Kang-Kol Mine, Chnng-An, Korea, Metallurgical Chemist.
1914. McFadyen, F. H., Canadian Rubber Co., Cor. Notre Dame and Papineau, Montreal, Canada, Chemist.
1902. McFarland, Alan R., c/o Solvay Process Co., Syracuse, N.Y., U.S.A., Alkali Works Manager.
1910. McFarlane, John, 6, Gordon Terrace, Shettleston, Glasgow, Metallurgist.
1893. McGhie, T. Burns, Bengate House, Applehy, Westmoreland, Metallurgist.
1904. McGill, Dr. A., 317, Queen Street, Ottawa, Canada, Analytical Chemist.

1899. **MacGillivray, Wm. A.**, c/o Swansea Safety Fuse Co., Pipe House Wharf, Swansea, Analytical Chemist.
1887. McGlashan, John, Post Office, Tolodi Balapur, Dist. Chanda, C.P., India, Technical Chemist.
1906. McGregor, Russell, 15, Frodingham Road, Scunthorpe, Lincolnshire, Analytical Chemist.
1896. McIlhiney, Dr. Parker C., 50, East 41st Street, New York City, U.S.A., Chemist.
O.M. McIlwaine, Alf. W., Stoneferry, Hull, Oil Manufacturer.
O.M. MacIndoe, G. D., Ness Street, Invercargill, New Zealand, Public Analyst and Consulting Chemist.
1914. MacInnes, Wm., 126, Dixon Avenue, Crosshill, Glasgow, Fire Surveyor.
1903. Macintire, Benj. Gould, 2226, West 17th Street, Wilmington, Del., U.S.A., Chemist.
1913. MacIntosh, George, 352, Elm Avenue, Westmount, Montreal, Canada, Glycerin Works Manager.
1914. McIntyre, A. Gordon, Bathurst, New Brunswick, Canada, Manager, Paper Mills.
1909. McIntyre, George D., c/o Morris and Co., National Stock Yards, Oklahoma City, Okla., U.S.A., Technical Chemist.
1914. MacIvor, R. W. Emerson, c/o Metals Recovery, Ltd., 47, Victoria Street, Westminster, S.W., Consulting Chemist.
1910. Mackay, Angus, Laboratory, Wellpark Brewery, Glasgow, Brewer's Chemist.
1911. Mackay, F., Oficina Agua Santa, Iquique, Chile, Analytical Chemist.
1914. McKay, Gordon P., 13, Prince Arthur Avenue, Toronto, Canada, Chemist.
1912. McKechnie, Alex., Chad Hill Cottage, Edgbaston, Birmingham, Copper Smelter.
1904. McKechnie, R. D., c/o British Aluminium Co., Ltd., Larne Harbour, co. Antrim, Ireland, Chemical Engineer.
1887. McKellar, W. G., c/o United Alkali Co., Ltd., St. Rollox Works, Glasgow, Technical Chemist.
1899. McKenzie, Alex. H., 17, North Street, North Adams, Mass., U.S.A., Colour Mixer.
1909. Mackenzie, Kenneth G., c/o The Texas Co., Bayonne, N.J., U.S.A., Chemist.
1893. McKerrow, C. A., 8, Berners Street Mansions, London, W.; and (Journals) c/o Mitchells, Ashworth, and Co., 23-24, Old Bailey, London, E.C. Consulting Chemist.
1893. McKesson, John, 91, Fulton Street, New York City, U.S.A., Manufacturing Chemist.
1911. McKey, Arthur W., 216, Milk Street, Boston, Mass., U.S.A., Sales Agent.
1891. Mackey, W. McD., Victoria Chambers, Leeds, Analytical Chemist.
1912. McKillop, G. F., Oilworks, Broxburn, West Lothian, Scotland, Works Chemist.
1890. McKillop, Jno., 32, Aynho Road, Hammersmith, W., and (Juls.) c/o W. Müller, 69A, Great Queen Street, Kingsway, W.C., Metallurgist.
1902. McKim, Wm., 37, Fairview Street, Yonkers, N.Y., U.S.A., Colour Maker.
1908. McLaren, Alex., 22, Moss Lane, Walton, Liverpool, Analytical Chemist.
1908. McLaren, Alex. W., 3, Hayfield Terrace, Langside, Glasgow, Analytical Chemist.
1898. McLaurin, Robt., Homesteads, Cambusbarron, Stirling, Chemist.
1905. McLellan, Basil G., c/o Rowntree and Co., Ltd., The Cocoa Works, York, Technical Chemist.
1910. MacLellan, George A., 1, Montague Terrace, Glasgow, W., Rubber Manufacturer.
1908. Macleod, Alex., Mount Pleasant, Old Kilpatrick, Dumbartonshire, Analytical Chemist.
1914. MacLeod, Fred, L., 694, Duke Street, Glasgow, Chemical Manufacturer.
1892. McLeod, Jas., Gas Works, Greenock, Manager.
1912. McMaster, Prof. Le Roy, Washington University, St. Louis, Mo., U.S.A., Assoc. Prof. of Chemistry.
1904. McMullen, Alan, Saint James' Gate, Dublin, Ireland, Brewer.
1895. McMurtry, Q. C., Templemore, Richmond, Nelson, New Zealand, Manager.
O.M. Macnab, W., 10, Cromwell Crescent, London, S.W., Analytical Chemist.
1907. McNaughton, Wm. G., Port Edwards, Wis., U.S.A., Chemist.
1908. McQueen, James, jun., Phœnix Chemical Works, Pollokshaws, Glasgow, Chemical Manufacturer.
1912. McRae, J. A., 184, University Avenue, Kingston, Ont., Canada, Research Chemist.
1914. McTavish, D. D., 626, Roslyn Avenue, Westmount, Quebec, Canada, General Manager, Canada Carbide Co.
1909. McWhirter, James, c/o Wm. Beardmore and Co., Laboratory, Parkhead Forge, Glasgow, Metallurgical Chemist.
1910. Madge, Norman, c/o Continental Rubber Co. of New York, 11, Vandewater Street, New York City, U.S.A., Chemist.
1895. Magnus, Isidor, 52, Leadenhall Street, London, E.C., Chemical Merchant.
1901. Magruder, Egbert W., Department of Agriculture, Richmond, Va., U.S.A., Chemist.
1912. Main, Hugh, Almondale, Buckingham Road, South Woodford, N.E., Analytical Chemist.
1898. Main, Wm., Piermont, N.Y., U.S.A., Chemist.
1905. Major, Ernest, "Seafield," Day Street, Drummoyne, Sydney, N.S.W., Manufacturing Chemist.
O.M. Major, J. Lewis, Welton Garth, Brough, East Yorks, Tar Distiller and Chemical Manufacturer.
1910. Male, C. E., c/o Bankoku Toryo Seizosho, P.O. Box No. 141, Kobe, Japan, Chemist.
1886. Mallinckrodt, Edw., Library, Mallinckrodt Chemical Works, St. Louis, Mo., U.S.A., Manufacturing Chemist.
1912. Manley, Chas. E., 8, Wilmington Gardens, Barking, Essex, Paint and Colour Works Manager.
1893. Mann, Harold H., Agricultural College, Poona, Bombay, India, Research Chemist.
1899. Mann, Jas. S., 19, Stopford Road, Upton Manor, Essex, Analyst.
1891. Mann, John C., 33, Nicholls Street, West Bromwich, Staffs, Chemist.
1914. Mann, Wilfred G., 37, Parliament Street, Westminster, S.W., Chemical Engineer.
1914. Mann, William, Messrs. Mann and Cook, 27, St. Mary Axe, London, E.C., Oil and Chemical Merchant.
1903. Mannhardt, Hans, 1104, Oakdale Avenue, Chicago, Ill., U.S.A., Chemical Engineer.
O.M. Mannington, H. T., Marshlea, Beaconsfield Road, Farnworth, Widnes.
1892. Mansbridge, Wm., 4, Norwich Road, Wavertree, Liverpool, Chemist.
1904. Marckworth, O. S., Ohio Testing Laboratory, 426, Chamber of Commerce, Columbus, Ohio, U.S.A., Director.
1883. Markel, Dr. K. E., 20, Queen's Gate Terrace, South Kensington, S.W., Technical Chemist.
1905. Marland, Percy, c/o Brotherton and Co., Ltd., Provan Chemical Works, Glasgow, Technical Chemist.
1905. Marlatt, Wilbur T., Oakville, Ont., Canada, Leather Manufacturer.
1912. Marly, Dr. Simon M., 34, Arhour Street, Southport, Analytical Chemist.
1914. Marples, Morris E., 7, Alfred Road, Birkenhead, Chemist.
1904. Marris, H. C., 68, Schlüsselburg Prospect, Petrograd, Russia, Analytical Chemist.
1901. Marsden, Dr. Fred., Technical Institute, Madura, South India, Chemist.
1906. Marsden, Oliver, Manor Road Mill, Victoria Road, Leeds, Cashier.
O.M. Marsh, J. T., Ammonia Soda Works, Fleetwood, Lancashire, Chemist.
1883. Marsh, W., Union Alkali Co., Soho Works, Ancoats, Manchester, Chemical Manufacturer.
1895. Marshall, Arthur, Waverley Cottage, Naini Tal, India, Chief Chemical Examiner.
1895. Marshall, Francis G., 56, Bewick Road, Gateshead, Technical Chemist.

1908. Marshall, John, Cudbear Street, Hunslet, Leeds, Dyeware Manufacturer.
1913. Marshall, Philip W., c/o The Fred. Crane Chemical Co., Armoury Close, Bordesley Green, Birmingham, Lacquer Manufacturer (retired).
1883. Marshall, Wm., Laboratory, Ladybrook Road, Cheadle Hulme, Cheshire, Dyer.
1884. Marshall, Wm., 9, Castello Avenue, Putney Park, S.W., Analytical Chemist.
1904. Marston, John P., 247, Atlantic Avenue, Boston Mass., U.S.A., Merchant.
1894. Martin, Alex. M., Hillview, Twechar by Glasgow, Analytical Chemist.
1895. Martin, Chas. H., 50, Longmead Road, Claremont, Pendleton, Manchester, Oil and Soap Works Manager.
1913. Martin, Edwin J., c/o Jas. Martin and Sons, Luton, Beds, Bleacher and Dyer.
1911. Martin, Dr. G., 4, Bertram Road, Hendon, N.W., Science Teacher and Industrial Chemist.
O.M. Martin, N. H., Ravenswood, Low Fell, Gateshead-on-Tyne, Manufacturing Chemist.
1899. Martin, Wm. E., 111, Belle Vue Road, Durban, Natal, South Africa, Chemist.
1887. Martineau, Sydney, Streatham Grove, Norwood, S.E., Sugar Chemist.
1907. Martius, Dr. C. A. von, Voss Strasse 12, Berlin, Germany, Dyestuff Manufacturer (retired).
1894. Martyn, T. Graham, Box 5, Maraisburg, Transvaal, South Africa, Metallurgist.
1909. Marx, Robert J., 133–139, Finsbury Pavement, London, E.C., Engineer.
1908. Mason, Capt. Douglas H. C., Manufacturer.
1904. Mason, Dr. Edward D., 32, Vernon Road, Edgbaston, Birmingham, Scientific Apparatus Dealer.
1911. Mason, Francis A., c/o Murphy and Lonsdale, 4, Queen Square, Leeds, Analytical Chemist.
1915. Mason, Dr. Fredk. A., 21, Queen Square, London, W.C., Demonstrator in Chemistry.
1906. Mason, Dr. Frederic S., 90, Beekman Street, New York City, U.S.A., Manufacturing Chemist.
1904. Mason, Glen F., c/o H. J. Heinz Co., Pittsburg, Pa., U.S.A., Chemist.
1887. Mason, J. Francis, Eynsham Hall, Witney, Oxon.
1906. Mason, M. Edgar, 268, Fox Street, Aurora, Ill., U.S.A., Consulting Chemist.
1914. Mason, William O. S., The Woodbines, Staines Road, Sunbury Common, Middlesex, Analytical Chemist.
1906. Massa, Corradino, Castelguelfo Parmense, Parma, Italy, Sulphuric Acid and Fertiliser Manufacturer.
O.M. Masson, Prof. D. Orme, University of Melbourne, Victoria, Australia, Professor of Chemistry.
1908. Masson, R. Duncan, c/o Messrs. R. Silcock and Sons, Stanley Hall, Union Street, Liverpool, Analytical Chemist.
1902. Masujima, Prof. Bunjiro, c/o K. Takebe, 16, Gazenbocho, Azabuku, Tokyo, Japan, Prof. of Applied Chemistry.
1910. Matchet, Andrew S., 13, Bute Gardens, Muirend, Cathcart, Glasgow, Analytical Chemist.
1911. Mather, Hubert, Lonsdale Terrace, Whitefield, Lancashire, Chemist.
O.M. Mather, J., Blaydon Chemical Works, Blaydon-on-Tyne, Manager.
1900. Mather, Wm., c/o The Standard Chemical Iron and Lumber Co., Montreal, Canada, Chemist.
1915. Mathesius, Ant., P., c/o E. I. du Pont de Nemours Powder Co., 20, Bishopsgate, London, E.C., Representative.
1907. Matheson, A. Greville E., Hawkesbury, Chinley, Derbyshire, Engineer.
1890. Matheson, W. J., c/o Cassella Color Co., 182, Front Street, New York City, U.S.A., Chemical Merchant.
1901. Mathew, W. E. B. de Vere, Dinham, Hillside Gardens, Wallington, Surrey, Analytical Chemist.
1900. Mathews, Dr. Jno. A., c/o Halcombe Steel Co., Syracuse, N.Y., U.S.A., Managing Director.
1898. Mathewson, E. P., Anaconda, Mont., U.S.A., Metallurgist.
1888. Mátos, Dr. Lonis J., (Comms.) 103, North 19th Street, East Orange, N.J., and (Jnls.) c/o Cassella Color Co., 182–4, Front Street, New York City, U.S.A., Chemist.
1896. Matsui, G., 10, Nishikatamachi, Tokio, Japan, Chemical Engineer.
1912. Matthewman, Fred. P., Analyst's Office, L.B. and S.C. Railway Co., Brighton, Chief Chemist.
O.M. Matthews, Chas. G., 31, Stapenhill Road, Burton-on-Trent, Brewing Chemist.
1907. Matthews, Dr. F. E., Ashlawn, The Glebe, Blackheath, S.E., Technical Research Chemist.
1899. Matthews, Dr. J. Merritt, 5, Berwyn Street, East Orange, N.J., U.S.A., Professor of Chemistry and Dyeing.
1889. Mawdsley, W. H., G.P.O., Rockhampton, Queensland, Chemist.
1903. Maxim, Hudson, 698, St. Mark's Avenue, Brooklyn, N.Y., U.S.A., Chemist and Mechanical Engineer.
1894. Maxwell, Jno., Solway Chemical Works, Silloth, Cumberland, and (communications) English Street, Carlisle, Chemical Manure Manufacturer.
1903. Maxwell, Orin P., c/o West Virginia Pulp and Paper Co., Luke, Md., U.S.A., Chemist.
1911. May, Clarence E., 320, South Walnut Street, Bloomington, Ind., U.S.A.
1897. May, George H., 35, Graycliff Road, Newton Centre, Mass., U.S.A., Assistant Chemist.
1914. May, Leroy, 123, Cazenove Road, Stamford Hill, London, N., Chemist.
1884. Mayenfeld, Dr. E. von Salis. *See* Salis-Mayenfeld, Dr. E. von.
1903. Mayer, Andrew, jun., 176, Sixth Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1896. Mayfield, A. S., Oakdene, Newland Park, Hull, Analyst.
1892. Mayfield, H. B., Normanhurst, Mundy Street, Heanor, near Nottingham, Dyer.
1885. Mayhew, E. W. A., Manufacturing Chemist.
1909. Meanwell, Chas. W., 15, Woodlands Crescent, Muswell Hill Road, London, N., Analytical Chemist.
1898. Meeds, Alonzo D., 2424, Harriet Avenue, Minneapolis, Minn., U.S.A., Analytical Chemist.
1896. Meggitt, Loxley, Wheatsheaf Works, Alexandria, Sydney, N.S.W., Australia, Analytical Chemist.
1901. Meier, Dr. Franz, c/o Society of Chemical Industry in Basle, Basle, Switzerland, Chemist.
1888. Meikle, Jno., 8, Melrose Street, Great Western Road, Glasgow, Journalist.
1915. Meister, Fred, Laboratory Distiller Co., Ltd., Menstrie, Scotland, Analytical Chemist.
1902. Melcher, Arthur C., 58, Bowen Street, Newton Centre, Mass., U.S.A., Research Chemist.
O.M. Meldola, Prof. R., F.R.S., 6, Brunswick Square, London, W.C., Professor of Chemistry.
1911. Mellerio, Lucien P., 5, Coburg Mansions, Brunswick Square, London, W.C., Technical Assistant.
1912. Melling, S. E., Bank House, The Cliff, Higher Broughton, Manchester, Analytical Chemist.
O.M. Mellon, W. W., Woodlands, Blackrock, Co. Dublin, Ireland, Manufacturing Chemist.
1910. Mellor, Dr. Jos. W., 19, Villas, Stoke-on Trent, Ceramic Chemist.
1912. Mennell, Harold, 41, Wolverton Road, Stony Stratford, Bucks, Analytical Chemist.
1893. Mensching, Dr. C., Journals to Mersey Chemical Works, Bromborough Port, Birkenhead, Chemist.
1915. Menzies, R. C., Chemical Dept., The University, St. Andrews, Scotland, Chemist.
1892. Mercer, C. A., 34, Camomile Street, London, E.C., Chemical Apparatus Maker.
1890. Merck, Dr. E., Darmstadt, Germany, Juls. to 66, Crutched Friars, E.C., Manufacturing Chemist.
1905. Merck, George, Merck and Co., 45, Park Place, New York City, U.S.A., Manufacturing Chemist.
1899. Merrill, Frank H., 2420, Ocean View Avenue, Los Angeles, Cal., U.S.A., Factory Superintendent.

1906. Merrils, Fred. J., 25, Figtree Lane, Sheffield, Analytical Chemist.
1909. Merriman, C. E. B., 74, Trent Boulevard, West Bridgford, Nottingham, Technical Chemist.
1909. Merriman, H. J., 244, Victoria Park Road, South Hackney, N.E., Research Chemist.
1905. Merrin, A. C., 194–200, Bishopsgate, London, E.C., Assistant Editor and Analyst.
1904. Merry, Jno. B., 74, Park Hill Road, Harborne, Birmingham, Metallurgical Chemist.
1903. Mersan, Ferdinand de, Fairfield, Chestnut Avenue, Boston Spa, Yorks, Chemist.
1905. Merz, Eugene, Newark, N.J., U.S.A., Superintendent, Heller and Merz Co.
1897. Meslans, Prof. M., 6, Rue de Navarin, Paris, France, Professor of Chemistry.
O.M. Messel, Dr. R., F.R.S., 147, Victoria Street, London, S.W., Chemical Manufacturer.
1913. Metcalf, Frederick A., 16, Offord Street, Passaic, N.J., U.S.A., Chemist.
1899. Metcalf, Howard F., Farr Alpaca Co., Holyoke, Mass., U.S.A.
1886. Metcalf, Jno., Moorfield Chemical Works, Altham, near Accrington, Tar Distiller.
1908. Metcalfe, Ernest D., Messrs. Curtis's and Harvey, Ltd., Cannon Street House, London, E.C., Secretary.
1906. Methley, Bernard, Ferndale, Moorgate, Rotherham, Yorks, Engineering Chemist.
1898. Metz, Herman A., P.O. Box 753, New York City, U.S.A., Chemical Merchant.
1905. Metzis, Josef, Anglicia Petroleum Co., Drohobycz, Galicia, Austria, Manager of Refinery.
1900. Mewborne, Robt. G., c/o Kentucky Tobacco Products Co., Louisville, Ky., U.S.A., Chemist.
1907. Meyer, Dr. Erwin, c/o Morgan and Wright, Detroit, Mich., U.S.A., Chemist.
1898. Meyer, Dr. Franz, c/o R. Wedekind and Co., Uerdingen a/Rhein, Germany, Metallurgical and Chemical Engineer.
1904. Meyer, Prof. Dr. Richard, Technische Hochschule, Braunschweig, Germany, Professor of Chemistry.
1902. Meyrick, L. J., 137, City Road, Birmingham, Assistant Analyst.
1912. Michie, Arthur C., The Wallsend Laboratories, Wallsend-on-Tyne, Technical Chemist.
1909. Michie, John L., 13, Falside, Paisley.
1907. Micklethwait, Miss Frances M. G., 15, St. Mary's Square, Paddington, W., Chemist.
1911. Middlemass, Alphonso, 59, Promenade, Portobello, Midlothian, Works Chemist.
1904. Mighill, Dr. Thos. A., 15, Exchange Street, Boston, Mass., U.S.A., Chemist.
1896. Miles, G. Wellington, Room 214, 88, Broad Street, Boston, Mass., U.S.A., Analytical Chemist.
1889. Milestone, W. C., 45, Heathfield Road, Wandsworth Common, S.W., Chemical Works Manager.
1912. Millar, Chas. J., 23, James Street, Greenhead, Glasgow, Analytical Chemist.
1899. Millar, Jas. H., P.O. Box 4975, Johannesburg, Transvaal, Manufacturing and Analytical Chemist.
1909. Millar, Jas. Hill, Chief Chemist's Laboratory, St. James' Gate Brewery, Dublin, Chemist.
1883. Miller, Dr. A. K., Kilvert's Buildings, Withy Grove, Manchester, Analytical Chemist.
O.M. Miller, E. V., Sugar Works, Chelsea, Auckland, New Zealand, Sugar Works Chemist.
1914. Miller, Eric J., Carnbuck Club, Perambur Barracks, Madras, India, Chemist.
1889. Miller, Geo., Thorulea, Beaconsfield Road, Farnworth, Widnes, Technical Chemist.
1893. Miller, Dr. Harry E., 305, Palm Avenue, Oakland, Cal., U.S.A., Chemist.
1883. Miller, Dr. H. von. *See* Miller-Aichholz, Dr. H. von.
1894. Miller, Dr. John A., 44–45, Lewis Block, Buffalo, N.Y., U.S.A., Consulting Chemist, State Analyst.
1888. Miller, J. Hopkins, 86, North Frederick Street, Glasgow, Dyeworks Chemist.
1889. Miller, Jno. Poynter, Sandilands Chemical Works, Aberdeen, Technical Chemist.
1901. Miller, Stuart B., c/o Du Pont Powder Co., High Explosives Operating Dept., Wilmington, Del., U.S.A., Chemical Engineer.
1901. Miller, Dr. W. Lash, 50, St. Alban Street, Toronto, Canada, Associate Professor of Physical Chemistry.
1884. Miller, W. M., Caledonia Estate, Prov. Wellesley, Penang, S.S., Sugar Chemist.
1883. Miller-Aichholz, Dr. H. von, Beatrixgasse 32, Wien, Austria, Chemical Manufacturer.
1902. Milligan, R. E., New York Continental Jewell Filtration Co., 15, Broad Street, New York City, U.S.A., Chemical Engineer.
O.M. Mills, Prof. E. J., F.R.S., 64, Twyford Avenue, West Acton, W., Emeritus Professor of Technical Chemistry and Consulting Chemist.
1904. Mills, Dr. J. E., University of South Carolina, Columbia, S.C., U.S.A., Analytical and Consulting Chemist.
1905. Mills, Wm. Henry, 45, Wall Street, New York City, U.S.A., Merchant.
1905. Milne, Thomas, c/o The Gas Light and Coke Co., Ltd., Finsbury Court, Finsbury Pavement, London, E.C., Chemical Products Salesman.
1903. Milnes, Cresswell, The Cedars, Holborough, near Rochester, Cement Works Manager.
1887. Milnes, Edmund, Seedfield, Bury, Lancashire, Dyeing Extract Maker.
1902. Milnes, Ernest E., Park Print Works, Halifax, Yorks, Chemist.
1909. Mindeleff, Chas., c/o American Smelting and Refining Co., Maurer, N.J., U.S.A., Chemist.
1895. Miner, Harlan S., c/o Welsbach Light Co., Gloucester City, N.J., U.S.A., Technical Chemist.
1914. Miralles, A. D., Calle Pallars No. 29, Barcelona, Spain, Tanner and Leather Trades Chemist.
1895. Mitchell, Chas. A., c/o Beanfoy and Co., South Lambeth Road, S.W., Analyst.
1893. Mitchell, G. D. H., 559, Summer Avenue, Newark, N.J., U.S.A., Chemist.
1904. Mitsugi, R., c/o Tokio Gas Co., Senju Works, Senju, Tokio, Japan, Chemist.
O.M. Mitting, E. Kennard, 38, Harold Road, Norwood, S.E., Technical Chemist.
1909. Miyoshi, K., Osaka Gas Works, Iwasakisho, Nishiku, Osaka, Japan, Engineer.
1905. Modi, Dr. F. M., Meher Buildings, Tardeo, Bombay, India, Manufacturing and Analytical Chemist.
1910. Moe, Carl, Poydras, La., U.S.A., Chemist.
1906. Moe, Eldor H., Box 266, Salt Lake City, Utah, U.S.A., Chemist.
1914. Moffitt, Francis A., 61, South Pennsylvania Avenue, Wilkes Barre, Pa., U.S.A., Chemist.
1911. Mohan, Richard T., c/o The Douglas Packing Co., Granite Building, Rochester, N.Y., U.S.A., Chemist.
O.M. Mohr, Dr. B., 69A, Parliament Hill, Hampstead, N.W., Consulting Chemist and Metallurgist.
1894. Mole, Herbert B., Royal Albert Brewery, Queen's Road, Reading, Brewer.
1901. Mond, Dr. Albert L., c/o Hubers and Mond, 19, Southampton Buildings, Chancery Lane, London, W.C., Chemical Engineer.
1899. Mond, Emile S., 22, Hyde Park Square, London, W., Technical Chemist.
1891. Mond, Dr. Robt. L., Combe Bank, near Seven aks, Kent, Chemist.
1906. Monier-Williams, G. W., 32, St. Leonard's Terrace, Chelsea, S.W.
1908 Monk, Chas. W., 102, Bloomfield Road, Plumstead, Kent, Chemist.
1909. Monk, Reginald H., 388, Grosvenor Avenue, West mount, P.Q., Canada, Chemical Engineer.
1890. Moodie, Wm. E., Alexandria Works, Alexandria, Scotland, Analytical Chemist.
1905. Moody, Dr. Gerald T., Lorne House, North Dulwich S.E., Barrister-at-Law.
1898. Moody, Dr. Herbert R., College of the City of New York, and (Journals) 330, Convent Avenue, New York City, U.S.A., Professor of Chemistry.

1903. Mooney, F. Morgan, 118, Pembroke Road, Dublin, Chemical Manure Manufacturer.
1915. Mooney, Frank M., 32, St. Matthew Street, Montreal, Canada, Chemist.
1902. Mooney, Luke, 820, Granger Street, Fort Worth, Texas, U.S.A.
1887. Moore, Chas. C., 33, Clarendon Road, Garston, Liverpool, Chemist.
1901. Moore, Dr. Chas. W., c/o Crosfield and Sons, Ltd., Laboratory, Warrington, Chemist.
1907. Moore, Ernest P., c/o The Steel Co. of Canada, Hamilton, Ont., Canada, Chemist.
1911. Moore, Ernest W., c/o Messrs. T. G. Tickler, Ltd, Southall, Middlesex, Analytical Chemist.
1902. Moore, Fred., Victoria Chemical Co., Ltd., Victoria, B.C., Canada, Manufacturing Chemist.
1906. Moore, F. H., Messrs. G. H. Ogston and Moore, 87–89, Aldgate, London, E., Analytical Chemist.
1892. Moore, Dr. Geo. D., 201, Salisbury Street, Worcester, Mass., U.S.A.. Professor of Chemistry.
1914. Moore, Harold, c/o Mirrlees, Bickerton, and Day, Hazel Grove, Stockport, Chemist.
1912. Moore, Joseph W., Kinderton House, Runcorn, Works Chemist.
1914. Moore, Lawrence, 26, Welbeck Street, Wakefield, Dyer.
1905. Moore, Leslie R., 14, Elm Street, Concord, Mass., U.S.A., Chemist.
1899. Moore, Quintin, jun., c/o Wm. Beardmore and Co., Ltd., Parkhead Forge, Glasgow, Works Manager.
1885. Moore, R. T., 142, St. Vincent Street, Glasgow, Mining Engineer.
1899. Moore, Dr. Russell W., 121, Madison Avenue, New York City, U.S.A.; and Journals to University Library, Princeton, N.J., U.S.A., Chemist.
1890. Moore, Thos., 213, Heathfield Road, Birmingham, Analytical Chemist.
1910. Moorhouse Samuel, 138, New Road, Blackley, Manchester, Secretary and Oil Specialist.
1905. Moorwood, F. Colin, c/o W. H. Dyson, The Amalgams Co., Ltd., Attercliffe Road, Sheffield, Steel Manufacturer.
1903. Moran, Geo. A., 98, Massachusetts Avenue, North Andover, Mass., U.S.A., Chemist.
1902. More, Andrew, Ellesmere, King's Road, Walton-on-Thames, Analytical Chemist.
1903. Morfey, Harold, c/o The Mitchell Main Colliery Co., Wombwell, near Barnsley, Yorks, Manager of By-Products Works.
1901. Morgan, Dr. Gilbert T., Royal College of Science for Ireland, Dublin, Ireland, Professor of Chemistry.
1912. Morgan, Sidney, Petaling Estate, Selangor, Federated Malay States, Analytical Chemist.
1906. Morgan, Thos., "Meirion," Dovedale Road, Mossley Hill, Liverpool, Manufacturing Chemist.
1898. Morgan, T. M., 370, Wood Avenue, Westmount, Quebec, Canada, Cement Works Manager.
O.M. Moritz, Dr. E. R., 45, Great Tower Street, London, E.C., Brewing Chemist.
1885. Morley, Dr. H. Forster, 5, Lyndhurst Road, Hampstead, N.W., Professor of Chemistry.
1902. Morrell, Dr. R. S., Messrs. Mander Bros., Colour and Varnish Works, Wolverhampton, Chemist.
1884. Morrice, Jas. A., 1, Prince's Terrace, Dowanhill, Glasgow, Starch and Gum Manufacturer.
1906. Morris, A. H., 152, Chorley New Road, Bolton, Lancs, Brewer.
1898. Morris, Edgar F., Osney House, Brinnington, Stockport. Research Chemist.
1897. Morris, Harry, The Hall, Hexthorpe, Doncaster, Chemical Merchant.
1890. Morris, Herbert N., Gorton Brook Chemical Works, Manchester, Technical Chemist.
O.M. Morris, J. Haydn. *See* Haydn-Morris. J.
1908. Morris, Wm. J., 31, Prince Alfred Road, Wavertree, Liverpool, Chemist.
1911. Morrison, G. R., 318, Bath Street, Glasgow, Chemist.
1910. Morrison, J. A. S., c/o Clark, Son, and Morland, Ltd., Glastonbury, Somerset. Leather Chemist.
1910. Morrison, John W., Gas Offices, Sheffield, Gas Engineer.
1906. Morrow, Jas. M., 71, Tache Avenue, Norwood Grove, St. Boniface, Man., Canada. Analytical Chemist.
1901. Morse, Willard S., Seaford, Del., U.S.A., Manager.
1904. Morson, Thos. D., 14, Elm Street, Gray's Inn Road, London, W.C., Chemist.
1906. Morson, T. Pierre, 14, Elm Street, Gray's Inn Road, London, W.C., Chemical Manufacturer.
1907. Morton, George A., "Allindale," Upper Shirley Avenue, Shirley, Southampton, Chemist and Works Manager.
1897. Morton, Jno., North Road, St. Helens, Lancashire, Analytical Chemist.
1902. Mosbaugh, F. R., c/o Anglo-Canadian Leather Co., Huntsville, Ont., Canada, Chemist.
1911. Mosenthal, E. Macqueron de, 9, Rue Neuve, Versailles, France, Chemist.
1894. Moszczenski, J. B., 216, Ovington Avenue, Brooklyn, N.Y., U.S.A., Consulting Chemist.
1897. Motion, Jno., c/o The Joseph Dixon Crucible Co., Jersey City, N.J., U.S.A., Assistant Superintendent.
1887. Moul, Frank, Aldersgate Chemical Works, Southall, Technical Chemist.
1884. Moult, J., 3, Gladstone Terrace, Gateshead-on-Tyne, Secretary.
1898. Moulton, Prof. Chas. W., Vassar College, Poughkeepsie, N.Y., U.S.A., Professor of Chemistry.
1905. Moulton, Rt. Hon. Lord, F.R.S., 57, Onslow Square, London, S.W.
1892. Mount, Edw., Oaklands, Aughton, near Ormskirk, Assistant Secretary (United Alkali Company).
1905. Mrazek, F. M., 31, West Cromwell Road, London, S.W., Consulting Chemist.
1907. Mueller, Dr. Carl, Alte Weinsteige 48, Stuttgart, Germany, Chemist.
1890. Muir, Jas. Stanley, 23, Lilybank Gardens, Glasgow, Chemist.
O.M. Müller, Dr. H., F.R.S., 13, Park Square East, Regent's Park, London, N.W., Research Chemist.
1913. Mumford, Capt. E. Moore, Bio-chemist.
1896. Mundy, Lionel, 27, Merton Road, Kensington, W., Importer of Unfermented Wines.
1914. Munn, W. F., 518, Main Street, East Orange, N.J., U.S.A., Chemist.
1887. Munroe, Prof. Chas. E., George Washington University, Washington, D.C., U.S.A., Professor of Chemistry and Dean.
1900. Munton, Fred. T., Craigmore, Winsford, Cheshire A.R.S.M., Analytical Chemist.
1904. Murdoch, Alexander, Garden Suburb, Westerton Glasgow, Analytical Chemist.
1886. Murdoch, R. H. M., Norwood, Saltcoats, Ayrshire Explosives Chemist.
1899. Murphy, Albert J., 3 and 4, Queen Sqnare, Leeds Brewer's Chemist.
1901. Murray, Benjamin L., c/o Merck and Co., Rahway N.J., U.S.A., Chemist.
1903. Murray, Chas. B., 407, Perry Payne Building Cleveland, Ohio, U.S.A., Chemist.
1914. Murray, James P., The Canadian Oil Producing and Refining Co., Ltd., Petrolea, Ont., Canada. Mining Director.
1914. Murray, John E., c/o Emerson Drug Co., 64 Spadina Avenue, Toronto, Canada, Laboratory Superintendent.
1898. Murray, Rd., c/o Brotherton and Co., Ltd., Ammonia Works, Holmes Street, Leeds, Analyst.
1908. Murray, Dr. Thos. J., Municipal Technical School, Wolverhampton, Lecturer on Chemistry.
1905. Murrill, Dr. Paul I., c/o U.S. Rubber Co., 11th Avenue and 58th Street, New York City, U.S.A., Representative.
O.M. Muspratt, Dr. E. K., Seaforth Hall, near Liverpool, Alkali Manufacturer.
1894. Muspratt, Max, The Grange, Fulwood Park, Liverpool, Technical Chemist.
O.M. Muspratt, S. K., Alkali Manufacturer.
1907. Musso, Louis A., Box 956, G.P.O., Sydney, N.S.W., Australia, Technical Chemist.

1911. Myers, Ernest M., Sharrow, Basford Park, Stoke on Trent, Coke Oven Manager and Chemist.
1891. Myers, Dr. Wm. S., 25, Madison Avenue, New York City, U.S.A., Director.

## N

1902. Nacf, Dr. Ernest E., 17, Park Road, Clydach, Swansea, South Wales, Chemist.
1913. Nagase, Denzo, 36, Flanchford Road, Ravenscourt Park, W., Engineer.
1908. Nagle, J. C., c/o Nicholls, Nagle and Co., Ltd., Trafford Park, Manchester, Glucose and Starch Manufacturer.
1913. Nair, Valliyil G., Calico Mills, Ahmedabad, India, Chemist and Colourist.
1897. Nairn, Michael, Dysart House, Fife, Linolenm Manufacturer.
1909. Nakai, S., Miike Colliery Office, Omuta-machi, Chikugo, Japan, Engineer.
1903. Nakayama, T., c/o Fuji Paper Co., Mill No. 5, Yebetsu, Hokkaido, Japan, Chemist.
1912. Nanavati, Balabhai J., Rickey Road, Ahmedabad, India, Oil Manufacturer.
1893. Napier, Jno. W., Gas Works, Alloa, Scotland, Manager and Chemist.
1904. Napper, Sidney S., c/o S. Courtauld and Co., Ltd., Foleshill Road, Coventry, Chemist.
1897. Nash, L. Myddleton, Westlands, Princess Road, Finsbury Park, N., Industrial Chemist.
1910. Nash, N. C., Treleaven, Darling Street, Balmain East, Sydney, N.S.W., Works Chemist.
1908. Nasmith, M. E., c/o The Standard Chemical Co., Longford, Ontario, Canada, Chemist.
1914. Nathan, Albert F., Liberty Tower, 55, Liberty Street, New York City, U.S.A., Patent Lawyer.
1900. Nathan, Col. Sir Frederic L., 37, Cornwall Gardens, South Kensington, S.W., Superintendent Nobel's Explosives Works.
O.M. Naylor, W. A. H., The British Drug Houses, Ltd., 22-30, Graham Street, City Road, London, N., Manufacturing Chemist.
1909. Neal, C. S., Acme White Lead and Colour Works, Detroit, Mich., U.S.A., Manager.
1899. Neate, Percy J., 49, Frognal, Hampstead, N.W., Director of Cement Co.
1905. Neech, Herbert R., Doddington Lane, Swallowbeck, Lincoln, Chemical Engineer.
1905. Needham, Edward R., c/o The Northern Chemical Co., 16, Blythswood Square, Glasgow, Manufacturing Chemist.
1905. Neff, Robert W., 22, India Square, Boston, Mass., U.S.A., Chemical Manufacturer.
1906. Neil, Dr. Archibald A., c/o Brunner, Mond, and Co., Caxton House, Westminster, S.W., Chemical Engineer.
1890. Neill, Geo. D., 78, Drum Frochar Road, Greenock, Sugar Refiner.
1898. Neilson, Alex. McG., Umhilo, Durban, Natal, Analytical Chemist.
1911. Neilson, R. G., c/o Anglo-Persian Oil Co., Mohammerah, Persia (vid Bombay), Assistant Works Manager.
1902. Neish, Dr. Arthur C., Columbia University, New York City, U.S.A., Chemist.
1911. Nello, Vincent, Baldwin's Hill, Loughton, Artists' Colour Manufacturer.
1897. Nelson, Walter, Emscote Mills, Warwick, Gelatin Manufacturer.
1913. Neshitt, Cosby T., 17, Rupert Road, Nether Edge, Sheffield, Metallurgical Chemist.
1906. Nestell, Raymond J., c/o Western Precipitation Co., 1016, West Ninth Street, Los Angeles, Cal., U.S.A., Analytical Chemist.
1902. Nenmann, Dr. Edgar 7 and 8, Idol Lane, London, E.C.
1903. Neumann, Dr. Max, Dambachthal 9, Wiesbaden, Germany.
O.M. Newall, F. S., Washington Station R.S.O., Co. Durham, Chemical Manufacturer.
1905. Newall, Jos., Hill Cliffe, Heath Road, Runcorn, Cheshire, Chemist.
1889. Newberry, Spencer B., Sandusky Portland Cement Co., Baybridge, Erie Co., Ohio, U.S.A., Manager.
O.M. Newlands, W. P. R., 10, Cricklade Avenue, Streatham Hill, S.W., Sugar Chemist.
1914. Newman, Alex R., Havering House, Lewisham Hill, Lewisham, S.E., Chemical Engineer.
O.M. Newton, Jno., Verney Road, Rotherhithe New Road, London, S.E., Manure Manufacturer.
1912. Newton, Leonard O., 41, Bennett Park, Blackheath, S.E., Analytical Chemist.
1901. Nibelius, Axel W. T., c/o Neptune National Powder Co., Emporium, Pa., U.S.A., Chemist.
1904. Nichols, C. W., 25, Broad Street, New York City, U.S.A., Manufacturing Chemist.
1905. Nichols, E. Remington, 25, Broad Street, New York City, U.S.A., Treasurer (Nichols Chemical Co.).
1888. Nichols, Dr. Wm. H., 25, Broad Street, New York City, U.S.A., Chemical Manufacturer.
1905. Nichols, W. H., jnn., 25, Broad Street, New York City, U.S.A., Chemical Manufacturer.
1904. Nicholson, Wilfrid E., Hunslet Chemical Works, Leeds, Chemical Manufacturer.
1897. Nicholson, Wm. J., Ardeer, Stevenston, Ayrshire, Chemist.
1903. Nicoll, Frank, 28, Coudray Road, Southport, Chemist.
1905. Nieghorn, Albert, 120, Mill Street, Toronto, Canada, Agent.
1900. Nield, J. H., c/o General Chemical Co., Edgewater, N.J., U.S.A., Superintendent.
1898. Nightscales, Geo., 642, Holderness Road, Hull, Oil Merchant.
1899. Nihoul, Dr. Edw., 204, Rue St. Laurent, Liège, Belgium, Director of the Liège Tannery School.
O.M. Nimmo, Jas., 35, Whitworth Road, South Norwood, S.E., Analytical Chemist.
1907. Nims, H. E., c/o The Fiberloid Co., Indian Orchard, Mass., U.S.A., Chemist.
1885. Nishigawa, T., 5, Hikawa Cho, Akasaka, Tokyo, Japan, Works Director and Chemical Engineer.
1898. Nishikawa, Dr. T., Dept. of Applied Chemistry, Kyushu Imp. University, Fukuoka, Japan, Prof. of Applied Chemistry.
1908. Noble, Sir Andrew, Bart., K.C.B., F.R.S., Jesmond Dene House, Newcastle-on-Tyne.
O.M. Nölting, Prof. Dr. E., 27, Lazarethstrasse, Mülhouse, Alsace, Germany, Professor of Chemistry.
O.M. Norman, Sir Frederick J., Lyndhurst, Higher Runcorn, Cheshire, Chemical Manufacturer.
1892. Norman, J. T., 23, Leadenhall Street, London, E.C., Consulting Chemist.
1913. Norman, T. Stanley, Lyndhurst, Runcorn, Cheshire, Chemical Manager.
1890. Norman-Bott, Dr. Wm., 17, St. Helen's Place, London, E.C., Consulting Chemist.
1908. Norris, Wm. H. H., 16, Perham Road, West Kensington, W., Chemist.
1902. North, Barker, 33, Ashgrove, Great Horton Road, Bradford, Assistant Professor of Chemistry.
1909. Northcote, Reginald S., 28, Wellington Street East, Toronto, Chemist.
1905. Norton, Arthur L., 36, Purchase Street, Boston Mass., U.S.A., Dyestuff Merchant.
O.M. Norton, Dr. S. A., 363, East Town Street, Columbus, Ohio, U.S.A., Professor of Chemistry (Ohio State University).
1911. Norton, Samuel J., 22, Bushnell Road, Balham, S.W., Engineer and Manager.
1887. Norton, Dr. T. H., c/o Wm. Bryce, 54, Lothian Street, Edinburgh, U.S. Consul.
1899. Noyes, Henry, 499-501, Bourke Street, Melbourne, Victoria, Engineer.
1901. Noyes, Prof. Wm. A., University of Illinois, Urbana, Ill., U.S.A., Editor (J. Amer. Chem. Society).
1915. Nuttall, W. H., The Cooper Laboratory for Economic Research, Watford, Herts, Research Chemist.

## O

1910. Oakden, W. E., 2, Gledhow Terrace, South Kensington, S.W., Director of Research Laboratory.
1905. Oakes, F. J., jun., 141, Milk Street, Boston, Mass., U.S.A., Secretary, Oakes Manufacturing Co.
1904. Oberländer, Dr. Otto, 29, Queen Street, London, E.C., Research and Consulting Chemist.
1904. O'Brien, Claude H., Malgrave, Cairns, North Queensland, Supervising Chemist.
1900. O'Brien, Frederick, Pineleigh, Saltford, near Bristol, Analytical Chemist.
1905. Oburg, W. F., 33, Broad Street, Boston, Mass., U.S.A., Assistant Treasurer (Merrimac Chem. Co.).
1901. O'Connor, Chas. P., 7, Fairfield Street, Montclair, N.J., U.S.A., Analytical Chemist.
1908. O'Day, John, 15, Custom House Street, Boston, U.S.A., Dyestuff and Chemical Merchant.
1888. Oddy, Robert W., Abbey Street, Toad Lane, Rochdale, Chemist.
1911. Oehler, Prof. John, Carlstadt, N.J., U.S.A., Assoc. Professor of Chemistry (Columbia University).
1908. Ogilvie, Jas. P., Homedale, Hendon Lane, Church End, Finchley, N., Chemist.
1901. Ogston, Alex. G., Heath Park, near Aberdeen, Soap Manufacturer.
1903. Ohlenschlager, J. G., jun., Shanghai House, Botolph Lane, London, E.C., Chemical Merchant.
1905. Ohliger, Willard, c/o F. Stearns and Co., Detroit, Mich., U.S.A., Chemist.
1907. Oke, Alfred W., 32, Denmark Villas, Hove, Sussex, Solicitor.
1884. Oliver, F., 31, Horsley Hill Road, Westoe, South Shields, Analytical Chemist.
1912. Oliver, Ralph R., c/o Southern Fibre Co., Portsmouth, Va., U.S.A., Paper Chemist.
1888. Oliver, Wm. Letts, 251, Vernon Street, Oakland, Cal., U.S.A., Mining Engineer.
1910. Oliver, Willie, 30, Woodstock Street, Spotland, Rochdale, Works Chemist.
1914. Ollé, Arch. D., "Kareema," Charlotte Street, Ashfield, N.S.W., Australia, Electro-therapeutist.
O.M. Ollerenshaw, S., 94, Davyhulme Lane, Urmston, Manchester, Technical Chemist.
1906. Olmsted, Fred. A., c/o Willamette Pulp and Paper Co., Oregon City, Oregon, U.S.A., Chemical Engineer.
1904. Olney, Prof. L. A., 118, Riverside Street, Lowell, Mass., U.S.A., Professor of Chemistry and Dyeing.
1902. O'Noill, Chas., c/o Bleachers' Association, Ltd., 4, Norfolk Street, Manchester, Chemist and Colourist.
1907. Oppen, Wm. A., Vera Chemical Co., Stoneham, Mass., U.S.A., Chemist and Superintendent.
1905. Ormandy, Dr. W. R., Imperial House, Kingsway, London, W.C., Consulting Chemist.
1898. Ormerod, Dr. Ernest, 62, Dale Street, Liverpool, Consulting and Analytical Chemist.
1894. Ormerod, John, Globe Leather Works, Castleton, Manchester, Tanner and Currier.
O.M. Orr, A., 80, Hunter Street, Sydney, New South Wales, Analytical Chemist.
O.M. Orr, J. B., Crossacres, Woolton, Liverpool, Chemical Manufacturer.
1907. Ortved, Niels C., c/o Hiram Walker and Sons, Ltd., Walkerville, Ont., Canada, Chemist and Fermentologist.
1900. Osbourne, Jno. P., 6, Garrioch Drive, Maryhill, Glasgow, Analytical Chemist.
1900. O'Shaughnessy, Francis R., 42, Temple Street, Birmingham, Consulting Chemist.
1885. O'Shea, Prof. L. T., Dept. of Applied Science, St. George's Square, Sheffield, Professor of Applied Chemistry (University of Sheffield).
1912. Osius, George, Canadian Ammonia Co., Ltd., Foot of Meldrum Street, Detroit, Mich., U.S.A., Secretary and Treasurer.
1883. O'Sullivan, J., High Bank, Burton-on-Trent, Brewing Chemist.
1912. Oswald, Jacob, c/o Messrs. Fels and Co., 73rd Street and Woodland Avenue, Philadelphia, Pa., U.S.A., Soap Works Technical Manager.
1905. Otsuki, Prof. Chiri, Chemical Laboratory, Kyoto Imperial University, Kyoto, Japan, Professor of Applied Chemistry.
1898. Oushkoff, John P., Warwarka 5, Moscow, Russia, Chemical Manufacturer.
1906. Oxley, Horace F., c/o Jos. Crosfield and Sons, Ltd., Warrington, Chemist.
1908. Oxley, John C., Clayeroft, Guiseley, near Leeds, Aniline Colour Merchant.

## P

1904. Packard, C. T., Millhank, Bramford, near Ipswich, Manager of Chemical Works.
1886. Pagès, Albert, 34, Boulevard Henri IV., Paris, Technical Chemist.
1892. Paine, Augustus G., 200, Fifth Avenue, New York City, U.S.A., President of Paper Making Co.
1906. Palm, Otto G., 41, Colborne Street, Toronto, Canada, President (Atteaux Dye and Chemical Co.).
1903. Palmenberg, O. W., 50, East 41st Street, New York City, U.S.A., Consulting Chemist and Fuel Engineer.
1902. Palmer, Fred. G., c/o Curtis's and Harvey, Cliffe, Kent, Chemist and Acid Superintendent.
1887. Palmer, T. Chalkley, c/o American Dyewood Co., Chester, Pa., U.S.A., Manufacturing Chemist.
1887. Palmer, Thos. C., c/o W. J. Fraser and Co., Ltd., Dagenham, Essex, Engineer.
1907. Palmer, Wm. J., 25, Beech Hill Road, Eltham, Kent, Analytical Chemist.
1911. Paniker, Ramni, Consejo de Ciento 288, 2°, 2ª, Barcelona, Spain, Leather Trades Chemist.
1891. Parker, Edw., Laburnam House, Rushford Avenue, Levenshulme, Manchester, and (Jnls.) 142, Manchester Road, Denton, Manchester, Analytical Chemist.
1894. Parker, Dr. J. Gordon, Leathersellers' Technical College, 176, Tower Bridge Road, London, S.E., Principal.
1897. Parker, Prof. Matthew A., University of Manitoba, Winnipeg, Canada, Professor of Chemistry.
1901. Parker, Richard H., 147, Seymour Avenue, Newark, N.J., U.S.A., Analytical Chemist.
1894. Parker, Thos. J., 25, Broad Street, New York City; and (Jonrnals) Bayonne, N.J., U.S.A., Chemical Works Manager.
1903. Parker, Wm. B., 1, Murray Road, Rugby, Chief Chemist (British Thomson-Houston Co., Ltd.).
1901. Parker, Dr. Wm. Huntington, c/o U.S. Appraisers, General Delivery, Boston, Mass., U.S.A., Chemist.
1901. Parkes, Albert E., 43, Whitehorse Street, Stepney, E., Analytical Chemist.
1898. Parrish, Saml., 80, Grange Avenue, Chapeltown Road, Leeds, Teacher of Chemistry.
1914. Pascoe, Charles F., Canadian Steel Foundries, Ltd., Longue Pointe Works, Montreal, Canada, Metallurgist.
1909. Passmore, Dr. Francis W., 81, Queen Victoria Street, London, E.C., Consulting Chemist.
1902. Patch, Prof. Jas. A., Professor of Chemistry.
1897. Patchett, Col. Jas., Oakworth, Hadley, Wellington, Salop, Ironmaster.
1915. Paterson, J. H., 40, Blandford Street, Sunderland, Analytical Chemist.
1884. Paterson, John, Belle Isle Place, Workington, Cumberland, Mechanical Engineer.
1887. Paton, J. M. C., Messrs. Manlove, Alliott, and Co., Ltd., Nottingham, Mechanical Engineer.
1901. Patterson, Chas. A., Woodbury, N.J., U.S.A., Analytical Chemist.
O.M. Patterson, Geo., c/o The Manbré Saccharine Co., Ltd., Fulham Palace Road, Hammersmith, W., Technical Chemist.

1893. Patterson, Harry J., College Park, Prince George's Co., Md., U.S.A., Agricultural Chemist.
O.M. Patterson, T. L., Maybank, Finnart Street, Greenock, Sugar Works Manager.
1902. Patterson, Wm., Hamilton, Monksferry Chemical Laboratory, Birkenhead, Technical Chemist.
O.M. Pattison, Jas., Drimnamona, Kilmalcolm, Chemical Merchant.
1889. Pattison, Percy J., St. Budeaux, Devonshire Road, Hornchurch, Essex, Technical Chemist.
1909. Patton, H. G., c/o Fred Rueping Leather Co., Fond du Lac, Wis., U.S.A., Chemist.
1908. Paul, David M., c/o Japanese Explosives Co., Hiratsuka, Sagami, Japan, Chemist.
1891. Paul, Jas. H., 11, Glenluce Road, Blackheath, S.E., Analytical Chemist.
1900. Paul, Dr. L. Gordon, Market Hall Chambers, King Street, Huddersfield, Consulting Chemist.
1904. Payne, A. G. C., 6, Bradford Place, Penarth, near Cardiff, Chemist.
O.M. Payne, J. B., 13, Mosley Street, Newcastle-on-Tyne, Manufacturing Chemist.
1912. Peachey, S. J., "Tullamore," Priestnall Road, Heaton Mersey, Manchester, Lecturer in Chemistry.
1894. Pearce, Jas. Stanley, Priest's Mere, Tadworth, Surrey, Chemical Manufacturer.
1897. Pearce, Richard, 6, Beach Lawn, Waterloo, Liverpool, Metallurgist.
1883. Pearce, W., M.P., 14, Park Crescent, Portland Place, W., Chemical Manufacturer.
1903. Pearey, A. C., 43, Marlborough Mansions, Finchley Road, London, N.W., Director, Explosives Co.
1904. Pease, Fred N., P.O. Box 503, Altoona, Pa., U.S.A., Chemist.
O.M. Péchiney, A. R., Villa Les Rochers, Hyères (Var), France, Chemical Engineer.
1898. Peck, Dr. Ernest L., High Lawn, Bromborough, Cheshire, Chemist.
1894. Peden, Jno., 11, Duff Street, Greenock, Analytical Chemist.
O.M. Pedler, Sir Alexander, C.I.E., F.R.S., 28, Stanhope Gardens, Queen's Gate, London, S.W., Director of Public Instruction (retired).
1886. Pedler, J. R., 47, Tregunter Road, South Kensington, S.W., Clerk.
1906. Peile, Henry, Millhurn House, Newcastle-on-Tyne, and (Journals) c/o F. J. Willott, Victoria Gsresfield Colliery, Rowlands Gill, Co. Durham, Colliery Owner.
1897. Pellew, Chas. E., 111, East 78th Street, New York City, U.S.A., Adjunct Professor of Chemistry.
1912. Pellizza, Dr. A., Sta. Rosa, Necoxtla, Estada Vera Cruz, Mexico, Colourist.
1904. Pelly, Russell George, 3, Wingate Road, Hammersmith, W., Analytical Chemist.
1914. Penfold, A. R., Sydney Technical College, Harris Street, Sydney, N.S.W., Australia, Chemist.
1896. Penney, Mulgrave D., 11, High Street, Hull, Analytical Chemist.
1890. Pennock, J. D., o/o Solvay Process Co., Syracuse, N.Y., U.S.A., Technical Chemist.
1885. Pentecost, S. J., Alexandra Mount, Mapperly Hill, and (Journals) Lenton Works, Nottingham, Lace Dresser.
1892. Peploe, D. H. T., Underriver House, Sevenoaks, Kent.
1885. Perkin, A. G., F.R.S., Grosvenor Lodge, Grosvenor Road, Leeds, Technical Chemist.
1898. Perkin, Dr. F. Mollwo, 199, Piccadilly, London, W., Head of Chemical Department, Borough Polytechnic.
1887. Perkin, Dr. W. H., F.R.S., 5, Charlbury Road, Oxford, Professor of Chemistry.
1893. Perkins, T. S., 30, Tiffany Place, Brooklyn, N.Y., U.S.A., Chemist.
1912. Perrin, Wm. R., jnn., 530, King Street East, Toronto, Canada, Secretary and Treasurer.
1901. Perry, Chas. M., Greene, Kent County, R.I., U.S.A., Bleach and Dyeworks Chemist.
1887. Perry, David, 15, Woodlands Terrace, Glasgow, and (Journals) Forth and Clyde Chemical Works, Nitshill, near Glasgow, Manufacturing Chemist.
1895. Perry, Jos. H., 276, Highland Street, Worcester, Mass., U.S.A., Teacher of Chemistry.
1903. Perry, M. J. T., Australian Drug Co., O'Connell Street, Sydney, N.S.W., Australia, Manufacturing Chemist.
1903. Perry, Robt. Swain, 3500, Grays Ferry Road, and (Journals) Station D., Philadelphia, Pa., U.S.A., President (Harrison Bros. and Co.).
1914. Perry, R. W., 419, Keele Street, Toronto, Canada, Superintendent and Chief Analyst, Gums, Ltd.
1897. Peter, D. A. H., 2508, Broadway, New York City, U.S.A., Chemist.
1908. Peters, John M., c/o National Lead Co., 111, Broadway, New York City, U.S.A., White Lead Manufacturer.
1909. Petrie, A. Swanston, 6, Florida Street, Mount Florida, Glasgow, Analytical Chemist.
1903. Petrie, Dr. Jas. M., The University, Sydney, N.S.W., Australia, Chemist.
1902. Petsche, B. W., 60, Glenwood Avenue, Yonkers, N.Y., U.S.A., Chemist.
1906. Pettee, Chas. L. W., o/o Hartford Laboratory Co., Hartford, Conn., U.S.A., Chemist.
1892. Pettigrew, Robert, c/o Mersey and Irwell Joint Committee, 44, Mosley Street, Manchester, Electro-Chemist.
1902. Pettitt, Alf., c/o Chestnut Ridge Brick Co., 7, West 45th Street, New York City, N.Y., U.S.A., Chemist.
1912. Pfleiderer, Kurt, Westwood Works, Peterborough, Mechanical Engineer.
1888. Philip, Arnold, Chemical Laboratory, H.M. Dockyard, Portsmouth, Electro-Metallurgist and Electrical Engineer.
1908. Philip, Prof. James C., Imperial College of Science and Technology, South Kensington, S.W., Professor of Physical Chemistry.
1903. Philipp, Herbert, 152, High Street, Perth Amboy, N.J., U.S.A., Chemist and Electrochemical Engineer.
1912. Phillips, G. A., Laboratory, The Powell Duffryn Co., Aberdare, Mon., Chemist.
1911. Phillips, Henry A., Royal Gunpowder Factory, Waltham Abbey, Essex, Chemist.
1910. Phillips, Prof. Percy P., Thomason College, Rurki, United Provinces, India, Professor of Chemistry.
1895. Phillips, S. Chas., 47, Cannon Street, London, E.C., Chemical Engineer.
1911. Phillips, Capt. William E., Canada.
1898. Phillips, Wm. H., 100, Milton Avenue, East Ham, E., Soap Works Chemist.
1911. Philpotts, Wilfred C., 35, Sandford Avenue, Toronto, Canada, Gasworks Chemist.
1894. Picard, Hugh F. K., 44, London Wall, London, E.C., Metallurgist.
1904. Pickard, Glenn H., c/o American Linseed Co., 110th Street and Torrence Aveoue, South Chicago, Ill., U.S.A., Manager of Oils Dept.
1905. Pickard, Greenleaf W., Amesbury, Mass., U.S.A., Electrical Engineer.
1914. Pickard, J. Alleo, 50, Crooms Hill, Greenwich S.E., Consulting Metallurgical Chemist.
1902. Pickard, Dr. R. H., Billinge View, Blackburn Teacher and Analyst.
1914. Pickering, Walter J., Central Laboratory, City Gas Works, Nechells, Birmingham, Works Chemist.
1904. Pickup, Edgar H., 348, Great Clowes Street, Higher Broughton, Manchester, Calico Printer.
1913. Pierce, Jas. B., jun., Lock Box 932, Charleston, W. Va., U.S.A., Chemist, Barium Products Co.
1888. Pilkington, G., 9, Knowsley Street, Bury, Lancashire, Analytical Chemist.
1893. Pilley, Thos. W., 33, Grove Hill Road, Denmark Hill, S.E., Analytical Chemist.
1894. Pilling, John E., 229, Hornby Road, Blackpool, Chemist.
1906. Pincott, Emile S., 222. St. James' Street, Montreal, Canada, Manager (Nichols Chemical Co. of Canada, Ltd.).

1914. Pinkerton, Andrew, Vista Alegre 6, Minas de Rio Tinto, Huelva, Spain, Analytical Chemist.
1910. Pinnock, Douglas R., c/o The Nucoa Butter Co., 4th Street and Avenue A, Bayonne, N.J., U.S.A., Chemist.
1905. Pinnock, H. T., 11, Fountain Road, Edgbaston, Birmingham, Chemist.
1883. Pipe, Jas., Woodburn, Irvine, Scotland, Chemical Manufacturer.
1896. Piper, Walter E., Boston Rubber Shoe Co., Malden, Mass., U.S.A., Chemist.
1910. Pisart, F., 74, Avenue Blonden, Liège, Belgium, Chemical Engineer.
1907. Pitman, Brig.-Gen. John, 167, Berkeley Avenue, Orange, N.J., U.S.A., U.S. Army (retired).
1913. Pitt, Septimus A., Central Public Library, Coventry, Librarian.
1902. Pittard, Jno., West Ham Chemical Works, West Ham, E., Chemical Manufacturer.
1884. Pittuck, F. W., 19, Stratford Grove, Heaton, Newcastle-on-Tyne, Technical Chemist.
1909. Pintti, Prof. Dr. Arnaldo, Instituto Chimico-farmaceutico, R. Universita, Napoli, Italy, Director.
1899. Pizey, Jas. H., c/o S. Pearson and Son, The Refinery, Minatitlan, Vera Cruz, Mexico, Chemist.
1915. Platt, J. H., 17, Lansdowne Road, Crompsall, Manchester, Technical Chemist.
1894. Platten, Frank, c/o Elliot's Metal Co., Scilly Oak Works, near Birmingham, Metallurgical Chemist.
1890. Platts, Jno. C., "Sandygate," Chapel Lane, Wilmslow, Cheshire, Metallurgical Chemist.
1896. Plaut, Albert, P.O. Box 380, New York City, U.S.A., Wholesale Druggist.
1888. Playfair, David J., 7, Victoria Crescent, Dowanhill, Glasgow, Manufacturing Chemist.
1914. Plews, George, jnn., c/o Braden Copper Co., Molino, Rancagua, Chile, Chemist.
1907. Poetschke, Paul, c/o L. D. Caulk Co., Milford, Del., U.S.A., Chemist.
1914. Pollard, Henry, 1832, Lamont Street, Washington, D.C., U.S.A., Engineer.
1901. Pollard, Wm., Oakfield, Hitchin. Herts Chemist.
1904. Pollitt, Dr. Geo. P., 4, Whitehall Court, London, S.W., Chemist.
1902. Pollitt, Jas. C. T., 7, Grosvenor Road, Handsworth, Birmingham, Managing Chemist.
1883. Pollock, A., Kirkland, Bonhill, Dumbartonshire, Dyeworks Manager.
1890. Pomeroy, Dr. Chas. T., R. F. D. No. 1, Scotch Plains, N.J., U.S.A., Ink Manufacturer.
1909. Pond, Dr. Francis J., Stevens Institute of Technology, Hoboken, N.J., U.S.A., Professor of Chemistry.
1896. Pond, Prof. G. G., State College, Centre Co., Pa., U.S.A., Professor of Chemistry
O.M. Pond, J. A., 99, Queen Street, Auckland, New Zealand, Analytical Chemist.
1914. Pondal, Prof. M. Leguizámon, 726, Str. Mexico, Buenos-Aires, Argentina, Doctor of Chemistry.
1906. Pont, A. Felix do, Box 31, Wilmington, Del., U.S.A., Explosives Manufacturer.
1895. Pont, Pierre S. du, c/o Dr. C. L. Reese, E. I. du Pont de Nemours Powder Co., Wilmington, Del., U.S.A., Explosives Manufacturer.
1912. Pope, Chester H., 39, Waldemar Avenue, Winthrop, Mass., U.S.A., Ink Manufacturer.
O.M. Pope, S., 49, Provis Road, Chorlton-cum-Hardy, Manchester, Chemical Works Manager.
1899. Pope, Thos. H., The University, Edmund Street, Birmingham, Chemist and Lecturer on Brewing
1900. Pope, Prof. W. J., F.R.S., University Chemical Laboratory, and (Journals) Holmesdale, Brooklands Avenue, Cambridge, Professor of Chemistry.
1912. Porritt, E. D., c/o North British Rubber Co., Ltd., Castle Mills, Edinburgh, Chief Chemist.
1911. Porteous, Jas. W., c/o Bolckow, Vaughan, and Co., Ltd., Grange Hill, Bishop Auckland, Co. Durham, Chemist and Coke Oven Manager.
1902. Porter, J. Edw., P.O. Box 785, Syracuse, N.Y., U.S.A., Chemist.
1901. Porter, Jno. L., 3401, Panola Street, New Orleans, La., U.S.A., Chemist.
1884. Potter, Chas. E., Love Lane Sugar Refinery, Liverpool, Sugar Works Chemist.
1888. Potter, Chas. J., Heaton Hall, Newcastle-on-Tyne, Cement Manufacturer.
O.M. Potter, E. P., Chemical Works, Little Lever, near Bolton, Alkali Manufacturer.
1910. Potts, Harold E., 66, Leasowe Road, Wallasey, Cheshire, Patent Agent.
1915. Poulenc, Camille, 122, Boulevard St. Germain, Paris, France, Chemical Manufacturer.
1900. Powell, Harry J., 125, Thurlow Park Road, Dulwich, S.E., Glass Manufacturer.
1897. Power, Dr. Fred. B., 535, Warren Street, Hudson, N.Y., U.S.A., Research Chemist.
1907. Powers, Wm. A., c/o A. T. and S. F. R. R. Co., Topeka, Kans., U.S.A., Chief Chemist.
1902. Powney, Wm. E. F., 35, Priory Avenue, Hornsey, N., Analytical Chemist.
1912. Prasad, Prof. H., Government College, Ajmer, India, Professor of Science.
1897. Prentice, Dr. Bertram, Royal Technical Institute, Salford, Lecturer on Chemistry.
1902. Prentice, Dr. David, The Nook, Whitefield Road, Stockton Heath, Warrington, Chemist.
1903. Prentice, Jas., Cossipore Sugar Works, Cossipore, Calcutta, India, Chemist.
1911. Prescott, Alfred, 63, Corporation Street, Manchester, Chemical Agent.
1900. Prescott, Prof. Saml. C., 585, Boylston Street, Boston, Mass., U.S.A., Prof. of Ind. Biology.
1905. Preston, Jas. F., 403, Andover Street, Lowell, Mass., U.S.A., Manufacturing Chemist.
O.M. Price, Arthur F., 2503, Broadway, San Francisco, Cal., U.S.A., Analytical Chemist.
1905. Price, Dr. T. Slater, The Technical School, Birmingham, Lecturer on Chemistry.
1904. Prichard, Norman B., 40, Quebec Street, Sherbrooke, Quebec, Canada, Superintendent.
1905. Priest, Geo. Wesley, 78, Beech Street, East Orange, N.J., U.S.A., General Manager.
1899. Prinsen-Geerligs, H. C., Wanningstraat 17, Amsterdam, Holland, Director of Sugar Cane Experimental Station.
1912. Pritchard, Thos. W., Wilmington, N.C., U.S.A., Wood Distiller.
1912. Prittie, Frank H., Southern Pacific Railway Laboratory, Sacramento, Cal., U.S.A., Assistant Chemist.
1896. Prochazka, Dr. Geo. A., c/o Central Dyestuff and Chemical Co., Newark, N.J., U.S.A., Colour Manufacturer.
O.M. Procter, Prof. H. R., The Grange, Ilkley; and (Jnls.) The University, Leeds, Emeritus Professor of Tanning.
1884. Procter, J. W., Skeldergate Bridge, York, Manure Manufacturer.
1890. Proctor, Miss Anne J., Free Library, Widnes, Librarian.
O.M. Proctor, C., 118, Grosvenor Road, London, S.W., Analytical Chemist.
1901. Propach, C., 146, West Kinzie Street, Chicago, Ill., U.S.A., Colour Merchant.
1912. Propach, Dr. Wilhelm, Dynamit Act.-Ges. vorm. A. Nobel und Co., Alsterdamer 30r, Hamburg, Germany, Chemist.
1913. Prosser, Richard, c/o C. Tennant, Sons & Co., C.P.R., Telegraph Building, Montreal, Que., Canada, Chemical Agent.
1906. Pudney, S. H., 156, Bellwood Avenue, Toronto, Canada, Chemist.
1905. Pugh, John V., Guiting House, Allesley, near Coventry, Works Director (Rudge-Whitworth, Ltd.).
1899. Pullar, Edmund, Keirfield, Bridge of Allan, Scotland, Manufacturer.
O.M. Pullar, R. D., Pullar's Dyeworks, Perth, Scotland, Dyer.

1913. **Pulsifer, Lanson V.**, c/o Messrs. Valentine and Co., 364, Manhattan Avenue, Brooklyn, N.Y., U.S.A., Chemist.
1902. **Puntan, H. H. C.**, 10, London Chambers, Durban, Natal, Publin Analyst.
1894. **Purdie, Dr. Thos., F.R.S.**, 14, Sonth Street, St. Andrews, Professor of Chemistry.
1913. **Purves, G. Thomson**, Coke Ovens Dept., Anchengeich Colliery, Chryston, Scotland, Manager.
1905. **Pyman, Dr. Frank Lee**, "Sedgley," Selhorne Road, Sidcup, Kent, Chemist.

## Q

1903. **Queeny, Jno. F.**, Monsanto Chemical Works, 1800, Sonth 2nd Street, St. Louis, Mo., U.S.A., Chemical Manufacturer.
1903. **Queneau, Augustin L. J.**, Jemeppe aur Meuse, Belgium, Metallurgical Engineer.
1887. **Quibell, Oliver**, Shalem Lodge, Newark-on-Trent, Manure Manufacturer.
1902. **Quinan, Kenneth B.**, Cape Explosives Works, Somerset West, C.C., Sonth Africa, and (subscriptions) c/o Cape Explosives Works, Ltd., 15, St. Swithin's Lane, E.C., Snperintendent.

## R

1911. **Race, Joseph**, City Hall, Ottawa, Canada, City Bacteriologist.
1904. **Rademacher, Dr. Ferdinand**, Prag-Carolinenthal, Austria, Chemical Manufacturer.
1900. **Radley, Ernest G.**, 49, Ernest Street, West Norwood, S.E.
1902. **Ramsay, A. Alexander**, Laboratory, Department of Agriculture, 136, George Street, Sydney, N.S.W., Australia, Assistant Chemist.
O.M. **Ramsay, Sir William, K.C.B., F.R.S.**, Hazelmere, Bucks, Professor of Chemistry.
1885. **Ramsay, W.**, c/o Cammell, Laird, and Co., Ltd., Birkenhead Ironworks, Birkenhead, Chemist and Assayer.
1913. **Ramshottom, Dr. J. E.**, 98, Peabody Road, South Farnborongh, Hants, Chemist.
1906. **Ranck, Samnel H.**, Ryerson Public Library Building, Grand Rapids, Mich., U.S.A., Librarian.
1909. **Randall, George**, Severn Bank Tannery, Worcester, Tanner.
1910. **Ranken, Charles**, 19, Stockton Road, Sunderland, Analytical and Consulting Chemist.
1901. **Ransom, Francis**, The Chilterns, Hitchin, Herts, Manufacturing Pharmacentical Chemist.
1905. **Ransom, H. B.**, St. Stephen's House, Victoria Embankmont, Westminster, S.W., Consulting Engineer.
1910. **Ransome, A. Oswald**, Beechwood, Greenock Road, Paisley; and (Journals) Emlin Hall, Torver, Coniston, R.S.O., Lancashire, Works Chemist.
1898. **Raschen, Dr. Julius**, The Highlands, Runcorn, Cheshire, Consulting Chemist (United Alkali Co.).
1905. **Raschig, Dr. F.**, Ludwigshafen a/Rhein, Germany, Manufacturing Chemist.
1908. **Rassow, Prof. Dr. Berthold**, Stephanstrasse 8, Leipzig, Germany, General Secretary, Vereins Deutscher Chemiker.
1893. **Ratcliff, Frank D.**, Stourbank House, Stourport, Vinegar Brewer.
1904. **Ratcliffe, C. F.**, Haigh Park Chemical Works, Stourton, near Leeds, Tar Distiller.
1914. **Ratcliffe, Henry**, Leeds Phosphate Works, Ltd., Midland Road, Hunslet, Leeds, Technical Chemist.
1898. **Ratcliffe, Walter**, 21, Mawdsley Street, Bolton, Analytical Chemist.
1901. **Rawlins, Herbert J. L.**, The Crossways, Rainhill, Lancashire, Managing Director.
1903. **Rawolle, Frederick C.**, c/o Marx and Rawolle, 100, William Street, New York City, U.S.A., Chemist.
O.M. **Rawson, Chris.**, 22, Cumberland Street, Manchester, Consulting Chemist.
1909. **Rawson, H. Wyatt**, c/o Chartered Bank of India, Taiping, Perak, Fed. Malay States.
1909. **Rayner, Arthur B.**, Normanhurst, Alexandra Park Road, Muswell Hill, N., Chemical Broker.
1912. **Rayner, Edgar A.**, c/o Messrs. Johnson and Sons, 23, Cross Street, Finshury, E.C., Analytical Chemist.
1895. **Read, E. J.**, c/o Pretoria Portland Cement Co., Ltd., P.O. Box 405, Pretoria, South Africa, Analyst.
1914 **Read, Harold M.**, Waltaire, Newlay Wood, Horsforth, Leeds, Manufacturing Chemist.
1913. **Read, Dr. John**, University Chemical Laboratory, Cambridge, Assistant to Prof. of Chemistry.
1890. **Reade, Thos.**, 118, Tettenhall Road, Wolverhampton, Manufacturing Chemist.
1908. **Reavell, J. Arthur**, 37, Parliament Street, Westminster, S.W., Engineer.
1912. **Reddie, J. A.**, Sewage Disposal Works, Halifax, Yorks, Chemist.
1902. **Redfern, C. G.**, 15, Sonth Street, Finsbury, London, E.C., Patent Agent.
1914. **Redpath, G. C.**, 10, Dean Street, Newcastle-on-Tyne, Analytical Chemist.
O.M. **Redwood, Sir Boverton, Bart.**, 4, Bishopsgate, London, E.C., Petroleum Expert.
1887. **Redwood, Robt.**, 4, Bishopsgate, London, E.C., Secretary.
1886. **Rée, Dr. A.**, 15, Mauldeth Road, Withington, Manchester, Aniline Dye Manufacturer.
1902. **Reed, Herbert C.**, 227-229, Fulton Street, New York City, U.S.A., Cons. Tanning Chemist.
1906. **Reed, William**, c/o El Oro Mining and Railway Co., El Oro, Estado de Mexico, Works Manager.
1893. **Reekie, J. A.**, Buckton Grange, Stalybridge, Calico Printer's Colonr Mixer.
1883. **Reeks, T. H.**, 106, Queen Victoria Street, London, E.C., Analytical and Consulting Chemist.
1906. **Rees, Walter J.**, 36, Holly Lane, West Smethwick, near Birmingham, Glass Works Chemist.
1900. **Reese, Dr. Chas. L.**, Eastern Laboratory, P.O. Box 424, Chester, Pa., U.S.A., Chemist.
1913. **Regan, Colston J.**, 14, Penerley Road, Catford, S.E., Analytical Chemist.
1897. **Reid, Andrew**, c/o L. and J. McLellan, 65, Port Dundas Road, Glasgow, Chemist.
1909. **Reid, David E.**, Kodak Park, Rochester, N.Y., U.S.A., Chemist.
1906. **Reid, James**, Caldercruix Mills, by Airdrie, Scotland, Chemist.
1913. **Reid, J. Meston**, Vernon Lodge, Gateacre, Liverpool, Manufacturing Chemist.
1905. **Reid, Dr. John H.**, Westgarth, Eccles Road, Formby, Lancs, Chemist.
1907. **Reid, Robert**, Agencia de Tharsis, Huelva, Spain, Analytical Chemist.
1896. **Reid, Robt.**, Oil Mills, Horbury Bridge, near Wakefield, Chemist.
O.M. **Reid, Walter F.**, Fieldside, Addlestone, Surrey, Technical Chemist.
1893. **Reid, Wm., jnn.**, Bombay Dyeworks, Dadur, Bombay, India, Dyer.
1910. **Reiter, Dr. Kaspar**, Bayrischzell, Hochkrent, Bavaria, Chemist.
1898. **Reitmeyer, Robt. E. D.**, 63, Crutched Friars, London, E.C., Chemical Merchant.
1904. **Remington, Prof. Joseph P.**, 1832, Pine Street, Philadelphia, Pa., U.S.A., Anthnr, U.S. Pharmacopœia.
1900. **Remington, J. Stewart**, Aynsome, Grange-over-Sands, R.S.O., Lancs, Consulting Chemist.
1903. **Remsen, Professor Ira**, Johns Hopkins University, Baltimore, Md., U.S.A., Professor of Chemistry.
1911. **Renaud, Paul**, 8, Rue Nouvelle, Paris (9e), France, Consulting Engineer.
O.M. **Rennie, Dr. E. H.**, University of Adelaide, South Australia, Professor of Chemistry.
1911. **Rentschler, Mahlon J.**, c/o Oakland Chemical Co., Rosaville, Staten Is., N.Y., U.S.A., Bacteriologist.

1901. Renwick, Frank F., Sunny Side, Weald Road, Brentwood, Essex, Chemist (Photographic Works).
1907. Reoch, Robert A. S., Pacific Mills Printworks, Laurence, Mass., U.S.A., Printworks Superintendent.
1894. Rettie, Theodore, 10, Doune Terrace, Edinburgh, Metallurgical Chemist.
1895. Reubens, Chas. M., 68, Cliff Street, New York City, U.S.A., Chemist.
1912. Reuter, Dr. L., Apartado 6, Torréon, Coahuila, Mexico, Technical Director, "La Union S.A."
1905. Revis, Cecil, 5, Carlton Villas, Station Road, Barnes, S.W., Analyst.
1904. Reynard, Otto, 3, Selborne Villas, Manningham, Bradford, Yorks, Chemist.
O.M. Reynolds, Dr. J. Emerson, F.R.S., 3, Inverness Gardens, Kensington, W., Professor of Chemistry.
1912. Reynolds, Wm. Colebrook, "Wharfedale," Upminster, Essex, Manufacturing Chemist.
1913. Rhead, T. F. Eric, Sunnyside, Polygon Avenue, Levenshulme, Manchester, Research Chemist.
1908. Rhoads, J. Edgar, 2211, Shallcross Avenue, Wilmington, Del., U.S.A., Leather Chemist.
O.M. Rhodes, E., c/o Thos. Vickers and Sons, Widnes, Technical Chemist.
1892. Rhodes, P. J., Bridge House, Church, Accrington, Dye and Print Works Manager.
1889. Richards, Edgar, 60, Ayrault Street, Newport, R.I., U.S.A., Analytical Chemist.
1888. Richardson, Dr. Clifford, Room 1615, Woolworth Building, 233, Broadway, New York City, U.S.A., Chemical Engineer.
1903. Richardson, F. J., Chemical Works, Ringsend Docks, Dublin, Ireland, Chemical Manure Manufacturer.
1884. Richardson, F. W., County Analyst's Office, Bradford, Yorkshire, Analytical Chemist.
1900. Richardson, Jno. H., 57, Cavendish Drive, Rock Ferry, Cheshire, Manager.
1891. Richardson, Walter W., Aldingham, Park View Crescent, Roundhay, Leeds, Manufacturing Chemist.
1903. Richardson, Wm., Linfield, Wood Lane, Headingley, Leeds, Drysalter.
1894. Richardson, Wm. H., Newsky Thread Mills, Malaja, Bolotnaja, Petrograd, Russia, Textile Chemist.
1898. Richmond, Jno. R., The Hollies, Blurton, Longton, Staffs, Alkali Works Manager.
1901. Richmond, Sylvester O., Royal William Yard, Plymouth, Analytical Chemist.
1884. Rideal, Dr. Samuel, Laboratory, 28, Victoria Street, Westminster, S.W., Consulting Chemist.
1905. Ridge, H. M., 62, London Wall, London, E.C., Mining Engineer.
O.M. Ridsdale, C. H., Laboratory, 3, Wilson Street Middleshrough, Analytical Chemist.
1899. Riederer, Emil J., Forcite Works, Landing, N.J., U.S.A., Superintendent.
1902. Riederer, Dr. Herman S., 251, West 95th Street, New York City, U.S.A., Chemist.
1907. Rigg, Gilbert, c/o New Jersey Zinc Co., Palmerton, Carbon Co., Pa., U.S.A., Chemist
1892. Riker, Jno. J., 19, Cedar Street, New York City, U.S.A., Merchant.
1913. Riley, George, Effra Works, South Lambeth Road, London, S.W., Chemical Engineer.
1905. Riley, Louis J., 8, Newton Road, London, W., Chemist.
1912. Riley, Walter A., 100, King Street, Norwich, Brewer.
1899. Rink, Arnold, 11, Bridgewater Street, Barbican, London, E.C., Tannin Extract Manufacturer.
1889. Rintoul, Wm., "Lauriston," Ardrossan, Ayrshire, Explosives Chemist.
1901. Ripley, Philip F., 7, Abbott Street, Andover, Mass., U.S.A., Chemist.
1914. Ritchie, P. B., Box 894 G.P.O., Sydney, N.S.W., Australia, Manufacturer.
1907. Roberts, Chester, Swarthmore College, Swarthmore, Pa., U.S.A., Superintendent.
O.M. Roberts, F. G. Adair, Oak Hill Lodge, Hampstead, N.W., and Jnls. to H. Shankster, 57, Balfour Road, Ilford, Chemical Manufacturer.
1901. Roberts, H. E. U., c/o British Explosives Synd., Pitsea, Essex, Chemist.
1911. Roberts, H. W., Dynamite Factory, Somerset West, Cape Province, South Africa, Chemist.
1902. Roberts, Wm. H., City Analyst's Office, Ashton Street, Liverpool, Analytical Chemist.
1891. Robertson, Alex. A., Riversdale, Cressington Park, Liverpool, Technical Chemist.
1910. Robertson, Charles, c/o Messrs. S. Allsopp and Sons, Ltd., Burton-on-Trent, Brewer.
1900. Robertson, Jas., Barncraig, South Medrox, by Glenboig, Scotland, Analytical Chemist.
1910. Robertson, Dr. Joseph G., 19, Broomhill Terrace, Partick, Glasgow, Manufacturer.
1891. Robertson, Dr. Roht., Research Dept., Royal Arsenal, Woolwich; and (Journals) 29, Charlton Road, Blackheath, S.E., Research Chemist.
1910. Robertson, William, 21, Worfield Street, Battersea Park, S.W., Research Chemist.
1913. Robins, Edmund A., c/o Messrs. Kodak, Ltd., Wealdstone, Middlesex, Assistant Works Manager.
1913. Robinson, C. Stanley, Fern Villa, South Normanton, Alfreton, Works Chemist.
1897. Robinson, Clarence J., 708, Jewett Avenue, West New Brighton, N.Y., U.S.A., Chemist.
1902. Robinson, Hy. Fishwick, Culcheth Chemical Works, Newton Heath, Manchester, Manufacturing Chemist.
O.M. Robinson, H. H., 42, Penywern Road, Earl's Court, S.W., Analytical Chemist.
1907. Robinson, Herbert W., Robinson Bros., Ltd., Ryders Green, West Bromwich, Staffordshire, Tar Distiller.
1911. Robinson, Jas. H., 11, East Street, Rugby, Analytical Chemist.
O.M. Robinson, Jos., Farnworth, Widnes, Chemical Manufacturer.
1887. Robinson, Thomas, (Journals) 401, West Street, Glasgow; and (communications), The Villa, Nitshill, Chemical Works Manager.
1902. Rohitschek, Carl, 200, Worth Street, New York City, U.S.A., Scientific Brewer.
1915. Rocha, João, Villa Nova de Lima, Minas Geraes, Brazil, Assayer and Chemist.
1884. Rodger, Edw., 1, Clairmont Gardens, Glasgow, W.
1914. Rodger, Lawton H., Avonholm, Rutherglen, near Glasgow, Chemist.
1904. Rodger, Robert, Government Laboratory, Clement's Inn Passage, Strand, London, W.C., Chemist.
1905. Rodger, R. L., The Peña Copper Mines, Ltd., 736, Salisbury House, London Wall, E.C., Manager.
1909. Rody, Franz A., 258, Van Buren Street, Newark, N.J., U.S.A., Chemist
1903. Roelofsen, Dr. J. A., c/o Coal Distillation Co., Middleshrough, Yorks, Works Manager.
1910. Roessler, Dr. F., 89, High Street, Perth Amboy, N.J., U.S.A., Chemist.
1905 Rogers, Dr. Allen, Pratt Institute, Brooklyn, N.Y., U.S.A., Research Chemist.
1915. Rogers, Dr. F. M., c/o Standard Oil Co., Whiting, Ind., U.S.A., Chemist.
1900. Rogers, Geo. J., 32, Chndleigh Road, Brockley, S.E., Chemist.
1908. Rogers, Harry V., Ash Street, Ilkeston, Derbyshire, Engineer.
1907. Rogers, Henry L., Casilla 1118, Buenos Aires, Argentina, Analytical Chemist.
1909. Rogers, Herbert, c/o James Lyne Hancock, Ltd., 266, Goswell Road, London, E.C., Rubber Works Chemist.
1899. Rogers, John, c/o Nobel's Explosives Co., Ltd., Nobel House, Glasgow, Chemist.
1910. Rogers, L. Joslyn, Chemical and Mining Building, The University, College Street, Toronto, Canada.
1911. Röhm, Dr. Otto, Weiterstädterstrasse 4/6, Darmstadt, Germany, Chemist.
1898. Roller, H. C., 493, Central Avenue, Newark, N.J., U.S.A., Superintendent.

1899. Rollin, Chas., Bylton, East Jarrow-on-Tyne, Chemical Manufacturer.
1909. Rollin, Hugh, (subs) 1, St. Nicholas Buildings, Newcastle-on-Tyne, and (Jnls.) 1558, Kanawha St., Charleston, West Va., U.S.A., Chemical Manufacturer.
1907. Rolph, George M., c/o California and Hawaiian Sugar Refining Co., Crockett, Cal., U.S.A., Sugar Refiner.
1905. Romanes, J. W., Craig Knowe, Slatefoud, Edinburgh, Chemical Engineer.
O.M. Roscoe, Rt. Hon. Sir Henry, P.C., F.R.S., Woodcote Lodge, West Horsley, Leatherhead, Surrey, Consulting Chemist.
1904. Rose, Jno., Wicken House, Stretton, near Warrington, Technical Chemist.
1901. Rose, Jno. Leonard, 14, St. Vincent Road, Westcliff-on-Sea, Chemist.
1902. Rosebrugh, Prof. T. R., 2425 South State Street, Syracuse, N.Y., U.S.A., Professor of Electrical Engineering.
1897. Rosengarten, Dr. Geo. D., P.O. Box 1625, Philadelphia, Pa., U.S.A., Manufacturing Chemist.
1913. Rosenplaenter, Carlos B., c/o Henry S. King and Co., 65, Cornhill, London, E.C., Petroleum Technologist.
1893. Ross, Arthur, 1, Glengall Road, Old Kent Road, London, S.E., Analytical Chemist.
1900. Ross, Raymond, Public Analyst'e Office, Burnley, Lancashire, Analytical Chemist.
1910. Ross, Thos. M., c/o Burmah Oil Co., Ltd., Yenangyat Refinery, Upper Burmah, Analytical Chemist.
1910. Rossati, Guido, 226, Lafayette Street, New York City, U.S.A., Agricultural Chemist.
1911. Rossi, Dr. Carlo, 29, Via Leopardi, Milano, Italy, Electro-chemist.
1906. Rossi, Louis M., c/o General Bakelite Co., Perth Amboy, N.J., U.S.A., Works Manager.
1913. Rossini, Jas. L., c/o Anglo-American Oil Co., Purfleet, Essex, Oil Works Manager.
1906. Rossiter, E. C., Brougham, West Hagley, Worcestershire, Chemical Engineer.
1888. Rothwell, C. F. Seymour, Photographic Works, Mobberley, Cheshire, Chemist.
O.M. Rottenburg, Dr. Paul, 55, West Regent Street, Glasgow, Chemical Merchant.
1903. Rouse, Wm., The Knowe, Carlibar Street, Barrhead by Glasgow, Chemist.
1906. Rowell, Herbert W., 36, Thornbury Road, Osterley Park, W., Analytical Chemist.
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1904. Rowley, Ernest W., Chemical Laboratory, C.M.E. Department, North Eastern Railway, Darlington, Analytical Chemist.
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1901. Rowley, Walter Engene. c/o National Aniline and Chemical Co., 100, William Street, New York City, U.S.A., Chemist.
1904. Rowling, S. R., 1, Beechwood, Kendal, Westmoreland, Chemist.
1913. Rowse, Walter W., 30, Oliver Street, Boston, Mass., U.S.A., Representative of Cassella Color Co.
1915. Roy, Dr. Charles S., Summerfield Chemical Works, Wharf Road, Ponders End, Middlesex, Chemist.
1896. Royal-Dawson, H., Fernley House, Morrill Street, Hull, Chemist.
1898. Royle, Chas. L., c/o Cartavio Sugar Co., Trujillo, Peru, Sugar Chemist.
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1896. Ruddock, Fred. G., Corporation Street, Warrington, Analytical Chemist.
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1908. Rudolf, Prof. Norman S., Post Box 12A, Royal Automobile Club, London, S.W., Professor of Applied Chemistry.
1909. Rudorf, Dr. G., 52, Cranley Gardens, Muswell Hill, N., Manufacturing Chemist.
1884. Ruffle, Jno., Musley, Ware, Herts, Consulting Chemist and Electrician.
1898. Ruhl, Louis, c/o Roessler and Hasslacher Chemical Co., 100, William Street, and (Jnls.) Box 0101, New York City, U.S.A., Chemical Merchant.
1909. Ruiloba, J. A., c/o U.S. Steel Corporation, 71, Broadway, New York City, U.S.A., Engineer.
1910. Rule, Dr. Alexander, The University, Liverpool, Lecturer in Chemistry.
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1899. Rumbold, Wm. R., Electro-metallurgist.
1913. Rumi, Dr. Tomás J., Salta 947, Buenos Aires, Argentina, Doctor of Chemistry.
1911. Runeckles, A. R., c/o Brotherton and Co., Ltd., Litherland Tar Works, Liverpool, Technical Chemist.
1903. Runyan, Elmer G., Hutchins Building, Washington, D.C., U.S.A., Chemist and Gas Inspector.
1899. Rushby, Wm., Oak View, Batley, Yorks, Analyst.
1906. Russell, David, Rothes, Markinch, Fife, Scotland, Paper Maker.
1912. Russell, George H., c/o Michaelis, Hallenstein, and Co. Propy., Ltd., Footscray, Vic., Australia, Leather Tradee Chemist.
1913. Russell, Stanley, Seifenfabrik Sunlight, Olten, Switzerland, Works Manager.
1912. Russell, Thomas F., 131, Steade Road, Sheffield, Analytical Chemist.
1910. Russell, William, 21, Eric Street, Widnes; Jnls. to c/o United Alkali Co., Pilkington-Sullivan Works, Widnes, Lancashire, Chemist.
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1909. Ryall, W. E., c/o North-West Soap Co., 63, Garden Reach, Calcutta, India, Soapworks Chemist.
1905. Ryan, Prof. F. G., c/o Parke, Davis, and Co., Detroit, Mich, U.S.A., Manufacturing Chemist.
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## S

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1896. Samuelson, Francis A. E., Sir B. Samuelson and Co., Ltd., Middlesbrongh, Ironmaster.
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1890. Saniter, E. H., Strafford Villa, Moorgate, Rotherham, Analytical Chemist.
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1911. Sauer, J., 121, Van Breestraat, Amsterdam, Holland, Sugar Chemist.
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1907. Saxe, Joel B., P.O. Box 1086, Montreal, Canada, Chemist.
1898. Saxe, Sigmond, 107, Manhattan Avenne, New York City, U.S.A., Manufacturing Chemist.
1890. Sayers, Jos. J., c/o Nobel's Explosives Co., Kingsway House, Kingsway, Londnn, W.C., Explosives Chemist.
1913. Scarfe, H. Crespin, "Chikatoo," Willifield Way, Hendon, N.W., Public Officer.
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1910. Schaefer, Dr. George L., New York Quinine and Chemical Works, 105, North 11th Street, Brooklyn, N.Y., U.S.A., Chemist and Technical Manager.
1912. Schapiro, Hugo H. B., Wadsworth, Ohio, U.S.A., Chemist.
1908. Schatzmann, Dr. Paul, Isleben bei Fluelen, Switzerland, Chemist.
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1906. Schroeder, C. M. E., Rutherford, N.J., U.S.A., Analytical Chemist.
1895. Schroeder, E. August, c/n Church and Dwight Co., 1416, Willis Avenue, Syracuse, N.Y., U.S.A., Chemist.
1908. Schüll, Gustav, Messrs. Carl Schleicher und Schüll, Düren, Rheinland, Germany, Filter Paper Manufacturer.
1904. Schultz, Carl R., 440, First Avenue, New York City, U.S.A., Mineral Water Manufacturer.
1901. Schultze, Wm., c/o General Chemical Co., Laurel Hill, Long Island, N.Y., U.S.A., Chemist.
1893. Schwab, Dr. L. C., Sedanstrasse 53, Bernburg, Anhalt, Germany, Technical Chemist.
1908. Schwalbe, Dr. Carl G., Neue Krongstrasse 17, Eberswalde, bei Berlin, Germany, Professor (Kgl. Forstakademie).
1907. Schwamm, Chas. A., o/o Antoine Chiris, 20, Platt Street, New York City, U.S.A., Chemist.
1889. Schweich, Emile. *See* Mond, Emile S.
1894. Schweitzer, Dr. H., Riverside Mansions, corner 113th Street and Riverside Avenue, New York City, U.S.A., Chemical Expert.
1906. Schwerin, Lorenz R., c/o Casein Co. of America, Bainbridge, N.Y., U.S.A., Vice-President.
1906. Scott, Alox. C., Explosives Manufacturer.
1891. Scott, Andrew, Royal Gunpowdor Factory, Waltham Abbey, Essex, Analytical Chemist.
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1912. Scott, Harold M., 32, Woodfield Road, Cheadle Hulme, Cheshire, Works Chemist.
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1912. Scott, Jno. William, 576, Church Street, Toronto, Canada.
1913. Scott, Wm. Chas., c/o The Bay View Foundry Co., Sandusky, Ohio, U.S.A., Chemist.
1907. Scott, Wm. F., c/o Madison Woollen Co., Madison, Maine, U.S.A., Manager.
1894. Scott-Smith, G. E., 67, Surrey Street, Sheffield, Analytical and Consulting Chemist.
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1898. Searle, Alfred B., The White Building, Sheffield, Consulting Chemist (Classes VIII. and IX.).
1905. Seeker, A. F., 160, Midwood Street, Brooklyn, N.Y., U.S.A., Food Analyst.
1907. Seelemann, Dr. A., o/n Sprengstoffwerke Dr. R. Nahnsen und Co., Münckebergestrasse 31, Hamburg, Germany. Managing Director.
1896. Seldner, Rudolph, 383, St. John's Place, Brooklyn, N.Y., U.S.A., Manufacturing Chemist.
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1905. Sellers, Geo. E., Hopton Lane, Mirfield, near Huddersfield, Aniline Colour Maker.
1898. Sen (Gupta), Nagendra Nath, 18, Lower Chitpur Road, Calcutta, India, Physician and Chemist.
1910. Sen, Prof. Rajendra Nath, Engineering College, Sibpur, Bengal, India, Professor of Tinctorial Chemistry.

1905. Sewell, B. F. Brooke, P.O. Box 1334, Washington, D.C., U.S.A., Chemical Engineer.
1890. Seyler, Clarence A., Public Analysts' Office, Nelson Terrace, Swansea, Chemist and Assayer.
1907. Seymour, Tom G., Kilton, Northway, Wavertree, Liverpool, Analytical Chemist.
1911. Seymour-Jones, Lieut. R.A., Research Chemist.
1903. Shacklady, T. G., Hope Point, Cliffe at Hoo, Kent, Technical Chemist.
1911. Shah, Prof. P. G., 759, Sankdi Sheri, Ahmedabad, India, Professor of Chemistry, Forman Christian College.
1906. Shah, Prof. S. J., Dhanasntar's Street, Ahmedabad, India, Consulting Chemist.
1892. Shanks, Arch., 5, Green Lodge Terrace, Greenhead, Glasgow, Chemist.
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1904. Sharples, G. H., Newton Gardens, Middlewich, Cheshire, Works Chemist.
1905. Sharples, Philip P., 110, Edgemont Road, Montclair, N.J., U.S.A., President (Natl. Coal Tar Co.).
1884. Sharples, Stephen P., 22, Concord Avenue, Cambridge, Mass., U.S.A., Analytical Chemist.
1911. Sharrock, Charles W., Lion Works, West Thurrock, Grays, Essex, Cement Manufacturer.
1900. Sharwood, Dr. Wm. J., c/o Homestake Mining Co., Lead, South Dakota, U.S.A., Metallurgical Chemist.
1900. Shattuck, A. F., c/o Solvay Process Co., Detroit, Mich., U.S.A., Chemist.
1915. Shaw, John H., Public Library, Bury, Lancashire, Librarian.
1913. Shaw, T. W. A., "Springfield," Dee View Road, Heswall, Cheshire, Process Manager.
1912. Shearman, Cecil H., The Tees Bone Mill, Thornaby-on-Tees, Managing Director.
1904. Shedden, Frank, 25, Middleborough Road, Coventry, Science Master.
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1912. Shelley, F. F., Apothecaries' Hall, Blackfriars, London, E.C., Analytical Chemist.
1912. Shelley, Wm. E., 20, Mount Street, Manchester, Engineer.
1911. Shelton, James, Government Laboratories, Singapore, S.S., Chemist.
1913. Shengle, J. C., c/o Major Bros., Ltd., Kiangsu Chemical Works, Shanghai, China, General Manager.
1892. Shenton, Jas. P., 37, Torbay Road, Chorlton-cum-Hardy, near Manchester, Analytical Chemist.
1906. Shepard, Jas. H., Experiment Station, Brookings, S. Dak., U.S.A., Agricultural Chemist.
1907. Shepheard, Fred. G., Hetland Cottage, Ruthwell, Dumfriesshire, Chemist.
1904. Shepherd, A. B., Copenhagen Oil Mills, Limehouse, London, E., Analytical Chemist.
1893. Shepherd, H. H. B., 8, The Park, Sidcup, Kent, Chemist.
1898. Shepherd, Reginald des F., Central Laboratory, Rhodes, Manchester, Printworks Chemist.
1909. Shepherd, Stephen W., c/o Brotherton and Co., Ltd., Nechells Chemical Works, Birmingham, Works Manager.
1899. Shero, John E., c/o Aluminium Co. of America, Niagara Falls, N.Y., U.S.A., Chemist.
1893. Shields, Dr. John, Minas de Rio Tinto, Prov. de Huelva, Spain, Chemist.
1896. Shimomura, Prof. K., Shinkarasumaru Kojinguchi Sagaru, Kyoto, Japan, Professor of Chemistry.
1905. Shoffstall, Arthur S., 269, Second Street, New Brighton, Staten Is., N.Y., U.S.A., Chemist.
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1902. Sibley, Samuel E., Hawthorne, King Street, Randwick, Sydney, N.S.W., Australia, Technical Chemist.
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1911. Simmons, Thos. A., c/o British Aluminium Co., Larne Harbour, Co. Antrim, Ireland, Analytical Chemist.
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1898. Simon, Dr. A., 80, Bishopsgate, London, E.C., Chemical Engineer.
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1911. Singh, Shersingh W., N.W. Railway, Sultanpur, Punjab, India, Engineer.
1899. Singmaster, J. Arthur, c/o New Jersey Zinc Co. of Penna., Palmerton, Pa., U.S.A., Chemist.
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1894. Skelton, John R., c/o Norwich Crape Co. (1856), Ltd., St. Augustine's, Norwich, Managing Director.
1897. Skertchly, W. P., Laboratory, 11, Billiter Square, London, E.C., Analytical Chemist.
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1911. Skjold, E., Erith Oil Works, Erith, Kent, Technical Manager and Chemist.
1904. Skowronski, S., c/o Raritan Copper Works, Perth Amboy, N.J., U.S.A., Chemist.

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1898. Smith, Alf. B., Ryecroft, Glossop, Derbyshire, Bleacher and Dyers' Manager.
1897. Smith, Allan, 30, Fountainhall Road, Edinburgh, Chemist.
1914. Smith, Andrew, c/o Leech, Neal, and Co., Ltd., Spondon, Derby, Colour Manufacturer.
1896. Smith, Andrew T., c/o Castner-Kellner Alkali Co., Ltd., 257, Royal Liver Building, Liverpool, General Manager.
1905. Smith, Arthur, Town End Chemical Works, Bramley, Leeds, Chemical Manufacturer.
1912. Smith, Arthur R., c/o Messrs. J. Watson and Son, Ltd., Whitehall Soap Works, Leeds, Chemist.
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1906. Smith, E. A. Cappelen, c/o American Smelting and Refining Co., 165, Broadway, New York City, U.S.A., Metallurgical Engineer.
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1911. Smith. E. Woodhouse, Central Laboratory, City Gasworks, Nechells, Birmingham, Chief Chemist.
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1906. Smith, Irwin J., P.O. Box 506, Troy, N.Y., U.S.A. Salesman.
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1897. Smith, James, Sunnyside, Groes Road, Cressington, near Liverpool, Analytical Chemist.
1903. Smith, James, "Lyndhurst," Frodsham, and (Jnls.) Ditton Copper Works, Widnes, Metallurgist.
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1898. Smith, R. F. Wood, 90, Lower Thames Street, London, E.C., Consulting Chemist.
1890. Smith, Dr. R. Greig, Linnean Society's House, Elizabeth Bay, Sydney, N.S.W., Bacteriologist and Chemist.
1890. Smith, Robert Watson, c/o The New Transvaal Chemical Co., Ltd., Delmere, Transvaal, South Africa, Chemical Works Manager.
1914. Smith, Stanley, The Ammonia Soda Co., Ltd., Lostock Gralam, near Northwich, Chemist.
1907. Smith, Thorn, 49, West Larned Street, Detroit, Mich., U.S.A., Chemist.
1910. Smith, Vincent, Athlone, Eagle Road, Wembley, Middlesex, Technical Chemist.
1903. Smith, Dr. Warren R., Lewis Institute, Chicago, Ill., U.S.A., Teacher.
O.M. Smith, Watson, 34, Upper Park Road, Haverstock Hill, N.W., Retired Editor and Chemist.
1908. Smith, Dr. Watson, jun., Cape Explosives Works, Somerset West, C.C., South Africa, Chemist.
O.M. Smith, Wilfred, 182, West Street, Glasgow, Chemical Manufacturer.
1910. Smith, W. C., c/o The Anchor Cable Co., Leigh, Lancashire, Analytical Chemist.
1909. Smith, Wm. G., 23, Wickham Way, Park Langley, Beckenham, Kent, Chemical Merchant.
O.M. Smithells, Prof. A., F.R.S., The University, Leeds, Professor of Chemistry.
O.M. Smithers, F. O., 171, Adelaide Road, London, N.W., and (Jnls.) c/o W. E. Harrison, Technical School, Goldshill Road, Handsworth, near Birmingham, Chemical Agent.
1902. Smoot, Albert M., 99, John Street, New York City, U.S.A., Analytical Chemist.
1909. Smoot, Chas. C., III., c/o C. C. Smoot and Sons Co., North Wilkesboro', N.C., U.S.A., Tanning Chemist.
1888. Snape, Dr. H. Lloyd, Balholm, Lathom Road, Southport, Director of Education for Lancashire.
1908. Snell, Professor John F., Macdonald College P.O., Prov. Quebec, Canada, Professor of Chemistry.
1896. Snowdon, J., jun., Messrs. Snowdon, Sons and Co., Millwall, E., Chemical and Oil Manufacturer.
1900. Sodeau, Dr. Wm. H., Torpedofabrik, Finme, Hungary, Chemist.
1903. Sohlman, Ragnar, Bofors, Sweden, Manager (A. B. Bofors Nobelkrut).
1894. Sohn, Chas. E., 31, Mattison Road, Hornsey, N., Analyst.
1912. Solomon, J. Berard, 56, Priory Road, Hampstead, London, N.W., Tannery Chemist.
1906. Solomon, M., Birmingham Carbon Works, Witton, Birmingham, Manager.
1895. Solvay, Armand, 25, Rue Prince Albert, Brussels, Gérant de la Société Solvay et Cie.

1914. Somerville, C. Winthorpe, South Metropolitan Gas Company, East Greenwich, S.E., Works Chemist.
1884. Sommer, Adolf, Corner 1st and Binney Streets, East Cambridge, Boston, Mass., U.S.A., Pharmaceutical Chemist.
1909. Sommer, Dr. Albert, Munchnerplatz 14 pt., Dresden, Germany, Engineer Chemist.
1912. Sorley, Jas., Novara, Mount Vernon, Glasgow, Analytical Chemist.
1904. Southall, A. W., Lower Priory, Birmingham, Manufacturing Chemist.
1904. Sontherden, F., 11, Gordon Road, Exeter, Teacher of Chemistry.
1890. Sowerby, Thos. H., Canal Soap Works, Vernoy Road, Rotherhithe, S.E., Soap Manufacturer.
O.M. Sowerby, W. M., c/o United Alkali Co., Ltd., Allhusen Works, Gateshead-on-Tyne, Manager.
1887. Spackman, Chas., Rosehaugh, Clitheroe, Lancashire, Portland Cement Manufacturer.
1910. Spackman, Henry S., 2211, Chestnut Street, Philadelphia, Pa., U.S.A., President of Engineering Co.
1904. Sparre, Fin, c/o E. I. du Pont de Nemours Powder Co., Experimental Station, Henry Clay P.O., Del., U.S.A., Director.
1913. Speedy, Alan, 1, Creighton Avenue, East Ham, Essex, Technical Chemist.
1904. Speiden, C. C., 46, Cliff Street, New York City, U.S.A., Chemical Merchant.
1905. Speight, W. E., Hacken Sewage Works, Great Lever, Bolton, Chemist.
1883. Spence, D., Manchester Alum Works, Manchester, Alum Manufacturer.
1911. Spence, Dr. David, Norwalk, Conn., U.S.A., Research Chemist.
1900. Spence, Howard, (Journals) Audley, Broad Road, Sale, Cheshire; and Alum Works, Manchester, Chemical Manufacturer.
1909. Spence, Jno., 74, Buchanan Street, Glasgow, Analyst.
1883. Spence, Jno. W., Tiviot Colour Works, Manchester Road, Stockport, Drysalter.
1903. Spencer, A. Gordon, 601—603, Canadian Express Building, Montreal, Canada. Chemist.
1913. Spencer, Richard D., Works Chemist.
1884. Spiegel, Dr. Adolf, Messel hei Darmstadt, Germany, Analytical Chemist.
1903. Spielmann, Dr. P.E., 21, Cadogan Gardens, London, S.W., Chemist.
1906. Spiera, Dr. V. G., c/o Inchiostrificio-Veneto, Treviso, Italy, Chemist.
1889. Spics, Adolph, 21, Broadwater Down, Tunbridge Wells, Chemical Merchant.
1885. Spiller, A., 20, Holly Avenue, Newcastle-on-Tyne, Electrician.
O.M. Spiller, J., 2, St. Mary's Road, Canonbury, London, N., Consulting Chemist.
1914. Spilman, G. H., c/o The Chiswick Polish Co., Chiswick, W., Works Chemist.
1896. Spoor, J. L., Rede Court, Rochester, Kent, Portland Cement Manufacturer.
1909. Sprague, F. O., c/o Cattarangus Tanning Co., Olean, N.Y., U.S.A., Chemist.
1912. Sprent, Dr. Colin, Chemical Engineer.
O.M. Squire, P. W., 413, Oxford Street, London, W., Pharmaceutical Chemist.
1910. Stadler, Hans, c/o Herr Kommerzienrat J. Stadler, Prague, Austria, Technical Chemist.
O.M. Stahl, Dr. K. F., 57th Street and A. V. Ry., Pittsburgh, Pa., U.S.A., Consulting Chemist.
1914. Staley, Homer F., Iowa State College, Ames, Iowa, U.S.A., Technical Director.
1904. Standfast, Jno. T., Prince Regent's Wharf, Silvertown, E., Chemist.
1906. Stanley, Wm., Great Barrington, Mass., U.S.A., Engineer.
1888. Stantial, Frank G., c/o Cochrane Chemical Co., Everett, Mass., U.S.A., Technical Chemist.
1885. Staples, H. J., The Old Hall, Spondon, Derby, Colour Manufacturer.
O.M. Stark, J. F., Rosedale, Bromhorough, Cheshire, Works Manager.
1896. Statham, Noel, c/o West Virginia Pulp and Paper Co., 200, Fifth Avenue, New York City, U.S.A., Engineer.
1907. Staud, Joseph E., c/o W. W. Lawrence and Co., Pittsburg, Pa., U.S.A., Chemist.
1904. Stauffacher, W., 64, Oberwilerstrasse, Basle, Switzerland, Chemical Works Manager.
1895. Stead, J. Christopher, 57, Chancery Lane, London, W.C., Technical Chemist.
O.M. Stead, J. E., F.R.S., 11, Queen's Terrace, Middlesbrough-on-Tees, Analytical Chemist.
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1915. Steedman, Geo., Kinerton, Kilwinning, Ayrshire, Chemical Manufacturer.
1896. Steel, Fred. W., c/o General Chemical Co., Ltd., Anhurn, Sydney, Australia, Works Manager.
1900. Steel, Jno. S., Achernar, Blackburn, Melbourne, Vic., Australia, Chemist.
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1914. Steele, George Francis, Room 7, 1358, East 47th Street, Chicago, Ill., U.S.A., Paper Manufacturer.
1915. Steger, Prof. Alph. M. A. A., Technical University of Delft, and (Juls.) 58, Olden Barneveltlaan, The Hague, Holland, Chemical Technologist.
1912. Steiner, Bernard C., Enoch Pratt Free Library, Baltimore, Md., U.S.A., Librarian.
1897. Steinhart, Dr. Oscar J., c/o Twite and Steinhart, 65, London Wall, London, E.C., Consulting Metallurgist.
1912. Steinhoff Fred., 24, Walhrook, London, E.C., Chemical Manufacturer.
1887. Stenhouse, T., 166, Drake Street, Rochdale, Analytical Chemist.
1908. Stenhouse, Thos., jun., Chemical Laboratory, H.M. Dockyard, Portsmouth, Analytical Chemist.
1904. Stephen, A. E., 67, Castlereagh Street, Sydney, N.S.W., Australia, Analytical Chemist.
1911. Stephens, C. E., Messrs. Stephens and Morgan, 2, Bury Court, St. Mary Axe, London, E.C., Chemical Merchant.
1884. Stephens, H. Chas., Avenue House, Finchley, N., Ink Manufacturer.
1892. Stephens, M. E., 57—60, Aldersgate Street, London, E.C., Ink Manufacturer.
1913. Stephenson, Guy, Bankfoot Laboratory, Crook, Co. Durham, Analyst.
1909. Stephenson, Henry H., 22, Claremont Avenue, New Malden, Surrey, Technical Chemist.
1909. Stephenson, Herbert F., 8, The Park, Mitcham, Surrey, Analytical Chemist.
1889. Stern, Arthur L., 148, High Street, Burton-on-Trent, Brewing Chemist.
1912. Sterne, Edward T., School of Mining, Queen's University, Kingston, Ont., Canada, Chemist.
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1903. Steven, A. B., Royal Technical College, Glasgow, Lecturer on Dyeing.
1914. Steven, George, 23, Denstone Road, Pendleton, Manchester, Pharmaceutical Chemist.
1907. Steven, Michael M., c/o The East India Distilleries, and Sugar Factories, Ltd., Kanham Bridge P.O., C.P., India, Analytical Chemist.
1899. Stevenot, G. A., 280, Baltic Street, Brooklyn, N.Y., U.S.A., Chemist.
1902. Stevens, Dr. Hy. P., Laboratory, 15, Borough London Bridge, S.E., Consulting Chemist.
1894. Stevens, Jno. H., c/o Librarian, The Celluloid Co., 3, Westcott Street, Newark, N.J., U.S.A., Manufacturing Chemist.
1908. Stevens, J. Venn, 147a, Clapton Common, London, N.E., Analytical Chemist.
1902. Stevens, M. White, H.M. Patent Office, Chancery Lane, London, W.C., Chemist.
O.M. Stevenson, W., Standard Works, 95a, Sonthwark Street, London, S.E., Chemical Manufacturer.

1913. Steward, H. Bernard, Rose Hill House, Coseley, near Bilston, Staffs, Enamel Chemist.
1912. Stewart, Allan E., 136, Bedford Road, Toronto, Canada, Chemist.
1901. Stewart, David B. D., Aberdeen Comb Works, Hutcheon Street, Aberdeen, Managing Director.
1903. Stewart, Jas., "The Gas World," 8, Bonverie Street, Fleet Street, London, E.C., Editor.
1909. Stewart, Jeffrey, India Refining Co., McKean and Swanston Streets, Philadelphia, Pa., U.S.A., Works Manager.
1890. Stowart, Roht., 46, Westbonrne Road, Luton, Chemical Works Manager.
O.M. Stewart, S., c/o Michael Nairn and Co., Ltd., Kirkcaldy, Fife, Technical Chemist.
1914. Stiasny, Prof. E., 8, Monk Bridge Road, Headingley, Leeds, Professor of Applied Chemistry.
1906. Stickland, Oliver W., c/o The New Explosivee Co., Ltd., Stowmarket, Suffolk, Works Chemist.
1904. Stieglitz, Dr. Julius, University of Chicago, Chicago, Ill., U.S.A., Associate Professor of Chemistry.
1904. Stiff, John T., 68, Dover Road, Northfleet, Kent, Works Chemist.
1903. Stillwell, Albert G., 76½, Pine Street, New York City, U.S.A., Chemist.
1914. Stock, Cyril J. H., 9, Houndgate, Darlington, Analytical Chemist.
1900. Stockdale, Edgar, c/o R. Dewhurst and Co., Ltd. Printworks, Batley, Yorks, Colour Mixer.
1888. Stockdale, Wm., Rosebank Printworks, Ramsbottom, near Manchester, Calico Printer.
1887. Stocks, H. B., 33, Prenton Park Road, Birkenhead, Cheshire, Analytical Chemist.
1903. Stoddard, Jesse D., 674, Woodward Avenue, Detroit, Mich., U.S.A.
1885. Stoddart, F. Wallis, Grafton Lodge, Sneyd Park, Bristol, Analytical Chemist.
1899. Stokes, Alf. W., Laboratory, Town Hall, Paddington Green, W., Public Analyst.
1910. Stokes, Edward S., o/o Metropolitan Board of Water Supply and Seworage, Pitt Street, Sydney, N.S.W., Australia, Medical Officer.
1900. Stone, Geo. C., c/o New Jersey Zinc Co., 55, Wall Street, New York City, U.S.A., Engineer.
1899. Stone, I. F., 100, William Street, New York City, U.S.A., Chemical Merchant.
1914. Stone, O. J., c/o Messrs. Day and Martin, Carpenter's Road, Stratford, E., Analytical Chemist.
O.M. Storey, 1. H., Haverhreaks, Lancaster, Chemical Manufacturer.
1914. Storie, George B., 62, Vineyard Hill Road, Wimhledon, S.W., Works Manager.
1902. Storr, Bertram V., 26, The Square, Garden Suhurb, Ilford, Essex, Chemist.
1914. Stott, Augustus P., 20-26, Brunswick Place, City Road, London, N., Manager.
1909. Strachan, Jas. T., c/o Price Bros. and Co., Ltd., Kenogami, Quebec, Canada, Technical Chemist.
1912. Strange, E. Halford, 7, Staple Inn, Holhorn, London, W.C., Technical Research Chemist.
1903. Strayer, D. W., 428, West King Street, York, Pa., U.S.A., Chemist.
1912. Strevens, J. E., c/o New Zealand Sulphur Co., Ltd., Room 31, Smeaton's Building, Auckland, New Zealand, Technical Chemist.
1903. Strickler, Emerson H., c/o General Chemical Co., 25, Broad Street, New York City, U.S.A., Chemist.
1909. Strivens, Percy R., 20, Cartmel Road, St. Annes-on-Sea, Lancs., Analytical Chemist.
1896. Stuart, Harry T. R., Fir Bank, Woolfold, near Bury, Printworks Manager.
O.M. Stuart, T. W., 7, Livingston Drive, Sefton Park, Liverpool, Alkali Works Manager.
1896. Stuhbs, Augustns J., Castellon de la Plana, Spain.
1903. Sturrock, Capt. G. C., R.A., Indian Cordite Factory, Aruvankad, Nilgiris, India, Assistant Superintendent.
1908. Snart, Arthnr B., c/o Johnson and Sons' Smelting Works, Panl Street, Finsbury, London, E.C., Bullion Refiner.
1895. Sudborough, Dr. J. J., Indian Institute of Science, Bangalore, India, Lecturer in Chemistry.
1889. Sulman, H. L., 44, London Wall, London, E.C., Chemist and Metallurgist.
1910. Sulzer, Albert F., 16, Beverly Street, Rochester, N.Y., U.S.A., Chemical Engineer.
1895. Summers, Bertrand S., c/o The Summers Fiber Co., Port Huron, Mich., U.S.A., Electro-Chemist.
1907. Sundar-Ram, Minakshi, c/o Parry and Co., Ranipettai, N. Arcot, Madras, India, Agricnltural Chemist.
1913. Sundeman, G., c/o C. E. Davis' Packing Co., Fleeton, Va., U.S.A., Chemist.
1912. Sutcliffe, J. A. L., c/o Price's Co., Ltd., Belvedere, Kent, Analytical Chemist.
1906. Sntermeister, Edwin, c/o S. D. Warren and Co., Cumberland Mills, Westhrook, Maine, U.S.A. Chemist.
1884. Sutherland, D. A., 26, Victoria Street, Westminster, S.W., and (Juls.) Fairfield Lodge, Twickenham, Consulting Technical Chemist.
1909. Sutherland, Daniel M., Ashgrove, Sunbury Common, Middlesex, Works Manager.
1894. Sntherland, Geo., Croft Cottage, Bonhill, Scotland, Chemist.
1887. Sutherland, Jas., c/o British Aluminium Co., Ltd., Larne Harbour, Co. Antrim, Ireland, Chemist.
1906. Sutherland, John, c/o The Bauxite Refining Co., Ltd., Hebburn-on-Tyne, Manager.
O.M. Sutherland, R. M., Lime Wharf Chemical Works, Falkirk; and Solsgirth, Dollar, Chemical Mannfacturer.
1886. Sutton, F. Napier, 21, Lydford Road, Cricklewood, N.W., Alkali Works Inspector.
1900. Sutton, W. Lincolne, Redwell Street, Norwich, Public Analyst.
1913. Swan, J. Waldron, 211, Castle Street, Lnton, Beds, Gas Works Chemist.
1906. Sweet, Everell F., 52, Union Street, Boston, Mass., U.S.A., Importer.
1905. Swenarton, W. Hastings, 2, Rector Street, New York City, U.S.A., Patent Lawyer.
1904. Swindells, Seth, Liverpool Road, Kidsgrove, Stoke-on-Trent, Chemist.
1912. Swinden, Dr. Thos., 12, Nether Edge Road, Sheffield, Metallurgist.
1901. Swinton, Ralph S., c/o W. J. Bush and Co., Inc., Linden, N.J., U.S.A., Analytical Chemist.
1912. Sykes, Charles D., Ivy Honse, Langley, near Birmingham, Chemical Works Manager.
1902. Sylow, Paul L. P. G., New Farm Sugar Refinery, Brisbane, Queensland, Analytical Chemist.
1906. Symes, Langford P., Belfast Freezing Works, Christchurch, New Zealand, Chemist.
1906. Symonds, Ahram E., Wick Lane Colour Works Old Ford Road, Bow, E., Colour Manufactnrer.
1910. Szilagyi, L. F., 39, Belsize Avenue, London, N.W., Consulting Engineer.

## T

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1914. Tack, Howarth K., Bella Vista, 5, Minas de Rio Tinto, Prov. de Hnelva, Spain, Chemical Engineer.
1910. Tainsh, Peter, 36, Green Lawn, Rock Ferry, Cheshire, Technical Chemist.
1909. Tait, Walter Scott, Innellan, Behington, Cheshire, Works Manager.
1896. Takagi, T., 10, Nishikatamachi, Hongo, Tokyo, Japan, Chemical Engineer.
O.M. Takamatsu, T., 13, Nishikatamachi, Hongo, Tokyo, Japan, Analytical Chemist.
O.M. Takamine, Dr. Jokichi, 550, West 173rd Street, New York City, U.S.A., Engineer.
1912. Talley, Herbert, c/o Hercules Powder Co., Wilmington, Del., U.S.A., General Manager
1910. Tanahashi, Dr. T., 486, Sendamachi, Fukagawa, Tokyo, Japan, Manufacturing Chemist.

1898. Tanaka, Keishin, Matsuba Hotel, Kudansaka, Uye, Tokyo, Japan, Chemist.
1900. Tankard, Arnold R., 67, Ferens Avenue, Cottingham Road, Hull, Analytical Chemist.
1911. Tarver, Percy, 2095, East 36th Street, Cleveland, Ohio, U.S.A., Chemist.
O.M. Tate, F. H., 9, Hackins Hey, Liverpool, Analytical and Technical Chemist.
1910. Tatlock, Chas. S. A., c/o The Standard Chemical Products Co., Ltd., Irvine, Scotland, Analytical Chemist.
O.M. Tatlock, R. R., 156; Bath Street, Glasgow, Consulting Chemist.
1902. Tatters, Hugh Lee, 21, Park Road, Hebburn-on-Tyne, Analytical Chemist.
1906. Tattersfield, Frederick, 96, Bewick Road, Gateshead-on-Tyne, Analyst.
1905. Taveau, René de Mortemer, 1809, North Calvert Street, Baltimore, Md., U.S.A., Chemist.
1903. Taylor, Alvin M., c/o General Chemical Co., Hegewisch, Ill., U.S.A., Chemist.
1902. Taylor, Arthur P., c/o John Taylor and Co., 531, Front Street East, Toronto, Ont., Canada, Soap Manufacturer.
1907. Taylor, C. Marshall, Port Reading, N.J., U.S.A., Chemist.
1886. Taylor, G. Crosland, Crane House, Crane Wharf, Chester, Electrical Engineer.
1894. Taylor, G. Midgley, Caxton House, Westminster, S.W., Analytical Chemist.
O.M. Taylor, H. E., 1, Alexandra Park Gardens, Glasgow, Lead Works Manager.
1883. Taylor, Jas., "Cartref," Brierley Street, Mosman, N.S.W., Australia, Government Metallurgist.
1898. Taylor, Jas. M., Tynevale, Groes Road, Cressington, Liverpool, Analytical Chemist.
1888. Taylor, J. Scott, North London Colour Works, Spring Place, Kentish Town, N.W., Technical Chemist.
1896. Taylor, Martin, 11, Park Road, Clydach, Glamorgan, Chemical Works Manager.
1901. Taylor, Sidney H., 63, Wolstenholme Road, Sharrow, Sheffield, Works Chemist.
1898. Taylor, Walter, 475, Grosvenor Place, Limefield, Bury, Lancs, Technical Chemist.
1905. Taylor, Wm. H., 36, Glenhouse Road, Eltham Park, Kent, Chemist.
1887. Teanby, G. W. A., Elvin Lodge, East Dereham, Norfolk, Analytical Chemist.
1899. Teas, Wm. Holmes, Marion, Va., U.S.A., Chemist.
1913. Tebbutt, Oswold N., 4, Salisbury Villas, Cambridge, Cement Works Manager
O.M. Teed, Dr. F. L., Chem. Laby., 9, Mincing Lane, London, E.C., Analytical Chemist.
1905. Teeple, Dr. J. E., 50, East 41st Street, New York City, U.S.A., Director.
1904. Teller, George L., 31, North State Street, Chicago, Ill., U.S.A., Chemist.
1906. Tempany, Dr. Harold A., Government Laboratory, St. John's, Antigua, West Indies, Analyst.
1913. Tennant, C. A., c/o C. Tennant Sons and Co. (Montreal), Ltd., C.P.R. Tel. Chambers, Montreal, Canada, Chemical Importer and Agent.
884. Tennant, Jas., Fairlie, Ayrshire, Lead and Colour Manufacturer.
913. Tennant, Robt., 9, Prince's Square, Strathbungo, Glasgow, Analytical Chemist.
896. Tennille, Geo. F., c/o Southern Cotton Oil Co., 206, Bay Street East, Savannah, Ga., U.S.A., Chemist.
908. Terleski, Fred. H., 11, Oaklands Road, Kersal, Manchester, Technical Chemist.
911. Terrey, Augustne G., c/o The Limmer Asphalte Paving Co., Ltd., Leamonth Wharf, Orchard Place, Blackwall, E., Chemist.
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1893. Tetley, C. F., Messrs. Jos. Tetley and Son, The Brewery, Leeds, Brewer.
1903. Thatcher, Ed. J., The Manor House, Chew Magna, near Bristol, Merchant and Manufacturer.
1909. Thaxter, Gerald N., c/o Brewer and Co., Worcester, Mass., U.S.A., Chemist.
1908. Theis, Dr. Friedrich C., Konigsteinerstrasse 60, Höchst a/Main, Germany, Chemist.
1910. Thom, T. Mathieson, Woodlands, Cheshunt, Herts, Chemical Engineer.
1908. Thom, Wm. H., 1024, Dovercourt Road, Toronto, Canada, Chemist.
1911. Thomas, D. Hibbert, 56, Waun Road, Morriston, Glamorganshire, Chemical Works Manager.
1912. Thomas, Frederick, c/o Williams Bros. and Co., Colour Manufacturers, Hounslow, Middlesex, Chemist and Works Manager.
1894. Thomas, H. Russell, Broad Plain Soap Works, Bristol, Soap Manufacturer.
1909. Thomas, John, Highfield, Brettell Lane, near Stourbridge, Analytical Chemist.
1902. Thomas, Nehemiah M., Wellesley Road, Pymble, N.S.W., Australia, Inspector.
1901. Thomas, Octavius, Gas and Water Offices, Pentre, Glamorganshire, Gas and Water Engineer.
1908. Thomas, Oswald J. D., c/o Canada Cement Co., Ltd., Plant No. 3, Hull, Quebec, Canada, Analytical Chemist.
1888. Thomas, S. Percy, c/o Baird and Tatlock, 14, Cross Street, Hatton Garden, London, E.C., Technical Chemist.
1898. Thomas, Wm. Harrison, jun., c/o The Apponang Co., Apponang, R.I., U.S.A., Printworks Chemist.
1905. Thomlinson, Wm., Seaton Carew Ironworks, West Hartlepool, Ironmaster.
1905. Thompson, Alf. J., c/o R. W. Greeff and Co., Thames House, Queen Street Place, London, E.C., Chemical Merchant.
1885. Thompson, Prof. Clande M., 38, Park Place, Cardiff, Professor of Chemistry.
1898. Thompson, Edw. C., Froyle House, 42, Westcombe Park Road, Blackheath, S.E., Manufacturing Chemist.
1909. Thompson, Edwin, 25, Sefton Drive, Liverpool, Manufactnring Chemist.
1914. Thompson, F. C., 183, Hyde Park Road, Leeds, Demonstrator in Leather Industries Department.
1893. Thompson, G. Rudd, 69, Dock Street, Newport, Mon., Analytical and Consulting Chemist.
1895. Thompson, Gustave W., 129, York Street, Brooklyn, N.Y., U.S.A., Chemist.
1913. Thompson, Howard, 52, Church Road, Northwich, Cheshire, Analytical Chemist.
1907. Thompson, Jas. G., Donegall Quay Mills, Belfast, Ireland, Corn Miller.
1903. Thompson, Jno. T., Corporation Sewage Works, Knostrop, Leeds, Analyst.
1912. Thompson, Kenworthy J., 644, Mahbett Avenue, Milwaukee, Wis., U.S.A., Chemist, Federal Rubber Works.
1907. Thompson, Milton S., 72, Broad Street, Boston, Mass., U.S.A., Manufacturer.
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1896. Thomsen, Alonzo L., Maryland Club, 1, East Eager Street, Baltimore, Md., U.S.A., Manufacturing Chemist.
1884. Thomson, G. Carruthers, 53, Bedford Road, Rock Ferry, Birkenhead, Engineer.
1907. Thomson, H. N., United Verde Smelter, Clarkdale, Arizona, U.S.A., Metallurgist.
1891. Thomson, Jas. M., Royal Gunpowder Factory, and (Jnls.) Powder Mill Lane, Waltham Abbey, Essex, Manager (Cordite Branch).
1884. Thomson, Robt. T., 156, Bath Street, Glasgow, Analytical Chemist.
1899. Thomson, Thos., c/o Waterproofing Co., Barrhead, near Glasgow, Manufacturer.

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1890. Thomson, Wm. Thos., Royal Gunpowder Factory, and (Jnls.) The Rowans, Honey Lane, Waltham Abbey, Essex, Explosives Chemist.

1902. Thorburn, Jas., 30, Cromartie Avenue, Newlands, Glasgow, Analytical Chemist.

1910. Thorne, Carl B., c/o Riordan Paper Co., Hawkesbury, Ontario, Canada, Manager.

O.M. Thorne, Dr. L. T., Highlands, The Crescent, Belmont, Surrey, and (Journals) Southampton Wharf, Battersea, S.W., Technical Chemist.

1907. Thornewell, A. R., 163, Rood End Road, Oldbury, Birmingham, Works Chemist.

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1904. Thornley, Thomas, 19, Hope Street, Glasgow, Chemical Manufacturer.

1887. Thornton, H., Redhourn, Ashford, Middlesex, Analytical Chemist.

1899. Thornton, Wm., c/o J. S. MacArthur and Co., Porcupine, North Ontario, Canada, Chemist.

1895. Thorp, Dr. Frank H., Mass. Inst. of Technology, Boston, Mass., U.S.A., Assistant Professor of Industrial Chemistry.

1906. Thorp, Walter, Sorrentoville, Dalkey, Co. Dublin, Ireland, Analytical Chemist.

O.M. Thorpe, Sir Edward, C.B., F.R.S., Whinfield, Salcombe, South Devon, Professor of Chemistry.

1905. Thorpe, Prof. J. F., F.R.S., The Imperial College, South Kensington, London, S.W., Professor of Organic Chemistry.

1905. Thresh, Dr. John C., Chelmsford, Essex, Medical Officer of Health and Sanitary Expert.

1898. Thurnauer, Dr. Gustav, c/o Aurora Metal Co., Aurora, Ill., U.S.A., Chemist.

1904. Thurston, Azor, Grand Rapids, Ohio, U.S.A., Chemist.

1904. Tickle, Thos., Laboratory, 83, Queen Street, Exeter, Analyst.

1913. Tilburn, Charles, The Australian Explosives and Chemical Co., Ltd., Deer Park, Vic., Australia, Works Manager and Explosives Chemist.

1908. Tillberg, Erik W., Westervik, Sweden, Extract Manufacturer.

1900. Tilley, Jas. W., 95A, Southwark Street, London, S.E., Research Chemist.

1906. Tillson, Henry E., 5946, Christian Street, Philadelphia, Pa., U.S.A., Dyer.

1901. Timmans, W. G., The Basford Chemical Co., Ltd., Basford, Nottingham, Chemical Manufactnrer.

1894. Tipler, Fred. C., 2, Wellington Villas, Crewe, Analytical Chemist.

1907. Tischbein, Dr. Robert, The Heyden Chemical Works, Garfield, N.J., U.S.A., Chemist.

1894. Toch, Maximilian, 320, Fifth Avenne, New York City, U.S.A., Chemist.

1915. Tocher, Dr. J. F., Crown Mansions, Union Street, Aberdeen, Public Analyst.

1886. Todd, A. M., c/o The A. M. Todd Co., Kalamazoo, Mich., U.S.A., Manufacturing Chemist and Distiller of Essential Oils.

1911. Todd, Fred W., Gunpowder Works, Tonbridge, Kent, Chemist.

1913. Tomlinson, George G., Anglo-Chilian Nitrate and Railway Co., Tocopilla, Chile, South America, Chemist.

1914. Tompkin, Albert, 101, Lenton Boulevard, Nottingham, Pharmacist.

O.M. Toms, F. Woodland, States Analyst's Office, St. Heliers, Jersey, Analytical Chemist.

1902. Tone, Frank Jerome, c/o The Carborundum Co., Niagara Falls, N.Y., U.S.A., Manager.

1909. Tonry, Wm. S., Passaic Street, near Elm Street, Maywood, N.J., U.S.A., Chemical Engineer.

1913. Toppin, Richmond D., Millett Street, Hurstville, Sydney, N.S.W., Chemist.

1907. Torrey, Dr. Joseph, Craigie Lea, Blundellsands, Liverpool, Engineer.

O.M. Towers, J. W., Widnes, Lancashire, Analytical Chemist.

1907. Towler, A. E., c/o Sulphide Corporation, Cockle Creek, N.S.W., Australia, Chemist.

1915. Townsend, Clinton P., 918, F. St. N.W., Washington, D.C., U.S.A., Patent Lawyer.

1897. Towse, Walter, Elswick Leather Works, Newcastle-on-Tyne, Technical Chemist.

1904. Toyne, Francis D., c/o Kelsal, and Kemp, Ltd., Woodhouse Mills, Norden, near Rochdale, Chemist.

1899. Trantom, Dr. Wm., Boräs, Grappenhall, near Warrington, Chemist.

1894. Traphagen, Dr. Frank W., Colorado School of Mines, Golden, Colo., U.S.A., Professor of Metallurgy and Assaying.

1900. Traquair, Jno., Ayer, Mass., U.S.A., Analytical Chemist.

1906. Travell, Norman E., Grosvenor Avenue, Mapperley Park, Nottingham, Lace Dresser.

1893. Travers, Dr. Morris W., F.R.S., 17, Lexham Gardens, London, W.

1889. Trechmann, A. O., The Old Palace, Rochester, Kent, Cement Manufacturer.

1911. Trechmann, C. T., Warren Cement Works, Hartlepool, Cement Manufacturer.

1895. Treharne, F. Gwilym, Wranghrook, Llanishen, near Cardiff, Analytical Chemist.

1909. Trier, Thorvald G., 237, West 22nd Street, New York City, U.S.A., Technical Chemist.

1901. Trigger, Oliver, Chem. Dept., Royal Arsenal, Woolwich, S.E., Analytical Chemist.

1898. Tripp, Dr. E. Howard, 3, Milton Road, Bedford Science Master.

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1897. Trotman, Saml. R., The City Laboratory, 1, Regent Street, Nottingham, City Analyst.

1887. Tsukiyama, S., 2nd of No. 2116, Fukiai-chō, Kobe, Japan, Paper Mills Chemist.

1894. Tucker, Alex. E., 55, Station Street, Birmingham, Metallurgist and Chemist.

1897. Tucker, Samuel A., Columbia University, New York City, U.S.A., Tutor in Industrial Chemistry.

1886. Tuer, Arthur H., Douglas House, Worthington, near Wigan, Analytical Chemist.

1903. Tufts, C. G., c/o Semet-Solvay Co., Syracuse, N.Y. U.S.A., Chemical Engineer.

1909. Tulloch, Capt. T. G., Bank Buildings, St. James Street, London, S.W., Director of Public Companies.

1901. Tulloch, Wm. F., c/o Joseph Watson and Sons, Ltd. Whitehall Soap Works, Leeds, Merchant.

1914. Tungay, Sydney J., Haughton's Ltd., 30, St. Mary at Hill, London, E.C., Chemical Engineer.

1909. Tunks, Dr. F. R., Powder Mills, Tonbridge, Kent Manager.

1904. Tunnell, Raymond W., 251, West Walnut Lane Germantown, Philadelphia, Pa., U.S.A., Manufacturer.

1899. Turnbull, Dr. Andrew, 18, Hackins Hey, Liverpool Consulting Chemist.

1888. Turnbull, G. W., Ash Cottage, North Road, Carnforth, Lancashire, Metallurgical Chemist.

1904. Turnbull, R. H., Messrs. Turnbull's (Glasgow) Ltd 20, Strand Road, Calcutta, India, Chemist.

1884. Turnbull, W. S., 38, Bath Street, Glasgow, Chemical Manufacturer.

1911. Turner, Prof. A. J., Technical Institute, Byculla Bombay, India, Professor of Chemistry.

1902. Turner, Basil, 83, Pitt Street, Sydney, N.S.W Australia, Metallurgist.

1902. Turner, Jos., c/o Read Holliday and Sons, Ltd and (Jnls.) Aso House, Birkby, Huddersfield Chemist.

1905. Turner, Prof. Thomas, 75, Middleton Hall Road, King's Norton, Birmingham, Professor of Metallurgy.
1897. Turney, Fred. N., 12, Dieghem Straat, Saventhem, near Brussels, Belgium, Leather Dresser.
1887. Turney, Sir J., Trent Bridge Leather Works, Nottingham, Tanner.
1908. Turnill, Thos. W., c/o Atlas Preservative Co., Windmill Lane, Deptford, S.E., Works Chemist.
1905. Tutwiler, Carrington C., Real Estate Trust Building, Philadelphia, Pa., U.S.A., Consulting Gas Chemist.
1890. Tweedy, Jas., 245, Burdett Road, Limehouse, E., Metallurgical Chemist.
1905. Twigg, Geo. F., 57, Val Plaisant, St. Heliors, Jersey, Gas Works Chemist.
1891. Twitchell, E., Wyoming, Ohio, U.S.A., Candle Works Manager.
1913. Twomey, Jerome, 21, Onslow Road, Elm Park, Liverpool, Research Chemist.
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1904. Tyler, Chas. R., c/o Dr. Francis Wyatt, 402, West 23rd Street, New York City, U.S.A., Analytical Chemist.
O.M. Typke, P. G. W., Lawn House, New Malden, Surrey, Chemical Manufacturer.
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## U

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905. Umney, John C., 48, Southwark Street, London, S.E., Wholesale Druggist.
889. Underhill, Thos. J., 53, Lanercost Road, Tulse Hill, S.W., Inspector of Stores.
885. Underwood, G. R., 10, Emerson Street, Peabody, Mass., U.S.A., Glue Works Chemist.
904. Uyeda, Toyokitsu, 54, Matsugayechō Kitaku, Osaka, Japan, Chemist.

## V

911. Vakil, Kapibram H., No. 5, Santa Cruz, Bombay, India, Chemist.
896. Van der Linde, Harold, c/o Century Rubber Co., Plainfield, N.J., U.S.A., President.
895. Vanderpoel, Dr. Frank, 175, Park Avenue, Orange, N.J., U.S.A., Chemist.
903. Van Dyck, Edwin M., 57, Greene Street, New York City, U.S.A., Chemist and Ink Maker.
897. Van Gelder, Arthur P., c/o Hercules Powder Co., Kenvil, N.J., U.S.A., Superintendent.
891. Van Gundy, Chas. P., Laboratory, B. and O. R. R. Baltimore, Md., U.S.A., Metallurgical Chemist.
896. Van Laer, Norbert, Truman's Brewery, Burton-on-Trent, Brewer and Chemist.
897. Van Marken, J. C., 10, Amalia Straat, The Hague, Holland, Chemical Engineer.
888. Vargas-Vergara, J. M., Apartado No. 120, Bogota, Colombia, S. America, Metallurgical Chemist.
910. Vass, David, Gas Works, Perth, Manager.
915. Vaughan, F. W., H. R. Vaughan and Co., Ltd., South Shore Road, Gateshead-on-Tyne, Roofing Felt Manufacturer.
912. Ventress, Ernest W. S., c/o Messrs. Lever Bros., Kabushiki Kaisha, P.O. Box Sannomiya 174, Kobe, Japan, Oil Mill Manager.
1898. Verity, Ben., 550, Hood Street, Fall River, Mass. U.S.A., Print Works Chemist.
1904. Vernon, Dr. R. H., 55, Rhatelstrasse, Zürich, Switzerland, Chemical Engineer.
1908. Vickers, Benj. Threlfall, Gascoigne Street, Boar Lane, Leeds, Oil Merchant.
O.M. Vickers, Wm., c/o Thos. Vickers and Sons, Miles Platting, Manchester, Chemical Manufacturer.
1907. Vietinghoff-Scheel, Dr. Karl Freiherr von, "Chemiker-Zeitung," Cöthen (Anhalt), Germany, Editor in Chief.
1908. Viéweg, Dr. Walter, Ganghoferstrasse 11, Frankfurt a/M., Germany, Chemist.
1909. Virolleaud, Leopold, 3, Rue de Paris, St. Denis, Seine, France, Chemical Engineer.
1897. Vlies, Leonard E., Belmont, Gowan Road, Alexandra Park, Manchester.
O.M. Voelcker, E. W., 1, Tudor Street, London, E.C., Analytical and Consulting Chemist.
1887. Voelcker, Dr. J. A., 20, Upper Phillimore Gardens, Kensington, W., Agricultural Chemist.
1897. Vogel, Julius L. F., Parliament Mansions, Victoria Street, Westminster, S.W., Engineer.
1899. Vogeler, Gustav, 17, Philpot Lane, London, E.C., Merchant.
1897. Voorhees, Louis A., 111, Carroll Place, New Brunswick, N.J., U.S.A., Agricultural Chemist.
1899. Voorhees, Samuel S., Bureau of Standards, Washington, D.C., U.S.A., Chemist.
1915. Vorce, L. D., c/o Pennsylvania Salt Manufacturing Co., Wyandotte, Mich., U.S.A., Superintendent.
1902. Vorisek, Dr. Anton, College of Pharmacy, 115—119, West 68th Street, New York City, U.S.A., Instructor.
1899. Voss, Walter A., Carlton Chemical Works, Glengall Road, Millwall, E., Manufacturing Chemist.

## W

1896. Wachtel, Gregory, Alexandrowski Prospect 15, Petrograd, Russia, Chemical Engineer.
1905. Waddell, Montgomery, 30, Church Street, New York City, U.S.A., Consulting Engineer.
1911. Waddock, Wm. P., 666, Harris Street, Ultimo, Sydney, N.S.W., Milk Analyst.
1913. Wade, Albert J., 21, Bengal Road, Ilford, E., Sugar Analyst.
1902. Wade, Frank, 26, St. Ronan's Avenue, Southsea, Analytical Chemist.
1890. Wade, Jas. L., 28, West Kensington Gardens, London, W., Chemical Manufacturer.
1889. Wadman, W. E., 102, Lord Avenue, Bayonne, N.J., U.S.A., Manufacturing Chemist.
1911. Waele, Armand de, c/o Linoleum Manufacturing Co., Staines, Technical Chemist.
1897. Wagner, Dr. Theodore B., Room 2229, 17, Battery Place, New York City, U.S.A., Chemist.
1893. Wagner, W. G., 12, North Common Road, Ealing, W., Manufacturing Chemist.
1906. Wahl, Dr. Robert, 1135—1147, Fullerton Avenue, Chicago, Ill., U.S.A., President, Brewers' School.
1895. Wainwright, Wm., c/o Spooner and Bailey, Manure Works, Eling, near Southampton, Chemist.
1908. Wait, Douglas, c/o R. Gay and Co., Ltd., Langthorne Works, Stratford Market, London, E. Analytical Chemist.
1899. Wakefield, Wm. C., Mill Street East, Savile Town, Dewsbury, Chemical Manufacturer.
1915. Waldo, Dr. Leonard, 49, Wall Street, New York City, U.S.A., Consulting Engineer.
1895. Waldstein, Dr. Martin E., 23, Broadwater Down, Tunbridge Wells, Kent, Manufactnring Chemist.
1887. Walker, Archibald, Newark Castle, Ayr, Scotland, Distiller.
1915. Walker, Arthur, "Woodbourne," Ancaster Road, Far Headingley, Leeds, Chemical Manufacturer.

1913. Walker, F. H., jnn., 3, Stannington Grove, Heaton, Newcastle-on-Tyne, Technical Chemist.
1914. Walker, Fred. W., Rosemont, Bath Street, Saltburn, Yorks, Analytical Chemist.
1908. Walker, George, c/o Burmah Oil Co., Ltd., P.O. Box 67, Rangoon, Burmah, Analytical Chemist.
1913. Walker, Henry, 10, Melrose Terrace, West Kensington Park, London, W., Chemical Engineer.
1897. Walker, H. V., 193, Lincoln Avenue, Newark, N.J. U.S.A., Chemist.
1894. Walker, Prof. Jas., D.Sc., F.R.S., 5, Wester Coates Road, Edinburgh, Professor of Chemistry (University of Edinburgh).
1897. Walker, Jas. W., Marine Lodge, Irvine, Scotland, Chemical Manufactnrer.
1906. Walker, Jas. W., Farley, Oakamoor, Stoke-on-Trent, Assayer.
1902. Walker, Jno. H., Gourepore Works, Naihati, E.B.S.R., Bengal, India, Chemist.
1910. Walker, John S., Hiratsuka, Sagami, Japan, Explosives Chemist.
1884. Walker, S. R., Fern Bank, Starling Road, Radcliffe, Manchester, Foreman Dyer.
1912. Walker, Prof. W. O., Dept. of Chemistry, School of Mining, Kingston, Ont., Canada, Professor of Chemistry.
1895. Walker, W. Sloane, c/o Walker, Ltd., Litherland, near Liverpool, Tanner.
1897. Wallace, Edwin C., 92, Corey Street, West Roxbury, Mass., U.S.A., Chemist.
1883. Wallace, Robert, 20, Murrayfield Avenue, Edinburgh, Distiller.
1897. Wallace, Robt. A., 66, Holland Road, London, W., Chemical Manufacturer.
O.M. Waller, Dr. Elwyn, 7, Franklin Place, Morristown, N.J., U.S.A., Professor of Chemistry.
1906. Wallerstein, Leo, 171, Madison Avenue, New York City, U.S.A., Chemist.
1899. Wallerstein, Dr. Max, 171, Madison Avenue, New York City, U.S.A., Chemist.
1913. Walmsley, Samuel R., c/o Chillagoe, Ltd., Forsayth, North Queensland, Australia, Assayer.
1886. Walsh, F. T., 12, Valentine Street, West Newton, Mass., U.S.A., Colour Printer.
1901. Walsh, Lionel O. P., c/o Dominion Tar and Chemical Co., Ltd., Sydney, Cape Breton, Canada, Chemist.
1903. Walsh, Peter H., P.O. Box 569, Magog, Quebec, Canada, Analytical Chemist.
1904. Walther, Wm., Holzapfel's Compositions Co., Ltd., Heworth Shore, Felling-on-Tyne, Chemist and Works Manager.
1908. Walton, Robert H., Railway Stores, Eveleigh, Sydney, N.S.W., Analyst.
1902. Walton, Thos. U., Colonial Sugar Refining Co., Ltd., O'Connell Street, Sydney, N.S.W., Australia, Analytical Chemist.
1911. Walton, Wm. Keighley, Beechwood, Upper Rushton Road, Thornbury, Bradford, Analyst.
1895. Want, W. Philip, 194—200, Bishopsgate, London, E.C., Pharmacist and Editor.
1901. Warburton, Frank, 50, Rosebery Road, Muswell Hill, N., Manager.
1904. Warburton, George H., 75, Mill Lane, West Hampstead, N.W., Analytical Chemist.
1896. Warburton, Thos., Rathlin, Birch Hall Lane, Rusholme, Manchester, Chemist.
O.M. Ward, Geo., Messrs. Hirst, Brooke, and Hirst, Ltd., Millgarth Mills, Leeds, Chemical Manufacturer.
1891. Ward, G. J., Hallam Fields, Ilkeston, Notts, Civil Engineer.
1898. Ward, John, Barnstone Blue Lias Lime Co., Ltd., Barnstone, Notts, Manager.
1899. Ward, Wm. J., 28, Sefton Road, Sale, Manchester, Chemist.
1908. Wardleworth, Theo. H., 32, St. Gabriel Street, Montreal, Canada, Manufacturing Chemist.
1902. Waring, W. Geo., Webb City, Mo., U.S.A., Metallurgical Chemist.
1913. Warner, Arthur L. D., P.O. Box 203, Edgewater, N.J., U.S.A., Sugar Refiner.
1899. Warnes, Arthur R., 13—17, Green Lane, Hull, Consulting Technical Chemist.
1912. Warren, E. Bruce, c/o Indian Rubber and Gutta Percha Telegraph Works Co., Silvertown, E., Consulting Analytical Chemist.
1890. Warren, Fiske, c/o S. D. Warren and Co., Laboratory, Cumberland Mills, Maine, U.S.A., Paper Manufacturer.
1901. Warren, Jno. E., Eagle Chemical Works, Barchester Street, Poplar, E., Tar Distiller.
1912. Warriner, C. E., c/o U.S. Government, Honolulu, H.T., U.S.A., Analyst and Bacteriologist.
1911. Washburn, Frank S., (Jnls.) c/o American Cynamid Co., Niagara Falls, Ont., Canada, President, American Cynamid Co.
1913. Wassmer, Dr. Eugene, Boulevard de la Tour, Geneva Chemist.
1885. Waterfall, W. B., c/o Avon Manure Co., Bristol; and (Journals) Thirlmere, Clavering Road, Redland, Bristol, Manure Manufacturer.
1902. Watkins, E. J., 72, King's Road, Peckham, S.E. Works Chemist.
1898. Watkins, Willard H., c/o Schoellkopf, Hartford and Hanna Co., P.O. Drawer 57, Buffalo, N.Y. U.S.A., Chemist.
1894. Watmough, Benj., c/o Brotherton and Co., Ltd. Ammonia Works, Wakefield, Chemist.
1884. Watson, Chas., Rose Bank, School Road, Moseley Birmingham, Manufacturing Chemist.
1894. Watson, Chas. Ernest, 33, Oxford Road, St. Annes on Sea, Lancashire, Chemical Assistant.
1908. Watson, C. I. Wilkinson, c/o Wailuku Sugar Co. Wailuku, Maui, Hawaiian Islands, Chemist.
1901. Watson, Herbert J., 64, Peel House Lane, Widnes Chemist.
1894. Watson, Jas., Tyne View, Hebburn-on-Tyne Alkali Works Manager.
1891. Watson, Jno., Langdon, Beaconsfield Road, Blackheath, S.E., Analytical Chemist.
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1901. Watt, Francis L., City Mart Building, 5, Hamilton Street, Sydney, N.S.W., Australia, Analytical Chemist.
1906. Watt, Dr. H. E., Blandfield Chemical Works, Whea field Road, Edinburgh, Chemist.
1893. Watts, Jno. Isaac, Fairleigh, Hartford, Cheshir Alkali Works Manager.
1908. Watts, Jno. Wm., Newcastle Tar Works, Blaydon-on-Tyne, Manager.
1907. Waumsley, Harry, 12, Rowhill Mansions, Clapton N.E., Chemical Engineer.
1903. Wayland, Wm. A., 12, Albert Road, Brockley, S.E. Manufacturing Chemist.
1906. Webb, Frank H., 7, Dustin Street, Haverhill, Mass U.S.A., Chemist.
1905. Webber, W. J., 40, Central Street, Boston, Mass U.S.A., Manufacturing Chemist.
1912. Weber, Dr. Max G., 151, Water Street, Perth Amboy, N.J., U.S.A., Works Manager.
1901. Webster, Geo. J., P.O. Box 1003, Marquette, Mich U.S.A., Secretary.
1906. Weddell, George, 20, Grainger Street West, Newcastle-on-Tyne, Manufacturing Chemist.
1904. Wedekind, Rud., Uerdingen, Niederrhein, Germany Manufacturer of Alizarin and Bichromates.
1897. Wedge, Utley, Ardmore, Pa., U.S.A., Chemist.
1902. Weed, Hy. T., 962, Ocean Avenue, Brooklyn, N.Y. U.S.A., Teacher of Chemistry.
1893. Weeks, H. B., 2, Infield Park Road, Barrow-in-Furness, Analytical Chemist.
1904. Weil, Jacob A., 4, Bowesfield Lane, Stockton-on-Tees, Chemical Engineer.
1910. Weinberg, Dr. Arthur von, "Buchenrode," Forsthaus-strasse, Frankfurt a/M, Germany, Dyestuff and Chemical Manufacturer.
1906. Weir, James, c/o Imperial Varnish and Color Co. 6—24, Morse Street, Toronto, Canada, Chemist

1910. Weiss, John M., c/o Barrett Manufacturing Co., Research Dept., Hudson Heights, N.J., U.S.A., Chemist.
1908. Weissmüller, Edward F., Spring Lodge, Helsby, Cheshire, Chemist.
1905. Weissmüller, Ernest C., "Ivy Dene," Overton, Frodsham, Cheshire, Research Chemist.
1910. Welch, Bertie M., 80, Hunter Street, Sydney, N.S.W., Australia, Assayer.
1912. Weld, Fred. C., 263, Fairmount Street, Lowell, Mass., U.S.A., Analytical Chemist.
1899. Weldon, Leonard E., Hadleigh, Alma Street, Sherwood Rise, Nottingham, Dyer.
1903. Wellcome, Henry S., Snow Hill Buildings, London, E.C., Manufacturing Chemist.
1914. Wells, E. E., 9, Dalhousie Street, Montreal, Quebec, Canada, Chemical Engineer.
1912. Wells, Jas. H., 21, Knoll Avenue, Uplands, Swansea, S. Wales, Metallurgist.
1885. Welsh, Jas., Standard Mills, Ferguson Road, Bombay, India, Printworks Manager.
1890. Welsh, Thos. L., 3, Prince's Gardens, Dowanhill, Glasgow, Analytical Chemist.
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1906. Wenger, Francis E., Clivedon, Wolstanton, Stoke-on-Trent, Ceramic Colour Manufacturer.
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1903. Wesener, Dr. John A., 31, North State Street, Chicago, Ill., U.S.A., Consulting Chemist.
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1908. West, Chas. A., c/o American Camphor Refining Co., 14, Fulton Street, Boston, Mass., U.S.A., President.
1909. West, Percy C. H., 61—62, Chancery Lane, London, W.C., Analytical Chemist.
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1885. Westmoreland, J. W., 12, Arthington Terrace, Hunslet, Leeds, Metallurgical Chemist.
1898. Weston, David B., Sharon, Mass., U.S.A., Chemist.
1894. Weston, Robt. S., 14, Beacon Street, Boston, Mass., U.S.A., Chemist and Bacteriologist.
1890. Wetter, Jasper, Room 23, Holborn Hall, Gray's Inn Road, London, W.C., Patent Agent.
1912. Weyman, Geoffrey, The Cwm, Saltwell Road, Low Fell, Co. Durham, Technical Chemist.
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1909. Wharton, Fredk. M., c/o The New Explosives Co., Ltd., Stowmarket, Suffolk, Chemist.
1908. Wheaton, H. J., 21, Chesterton Road, Cambridge, Chemical Engineer.
1909. Wheeler, Edward, 144, Earlsdon Avenue, Coventry, Demonstrator of Chemistry.
1898. Wheeler, Dr. Edwd. J., 79, Chapel Street, Albany, N.Y., U.S.A., Analytical Chemist.
1903. Wheeler, Ernest, 4, Fairfield Terrace, Higher Openshaw, Manchester, Metallurgical Chemist.
1906. Wheeler, Frank G., 683, Harris Street, Appleton, Wis., U.S.A., Chemist.
1907. Wheeler, R. Vernon, Home Office Experimental Station, Eskmeals, Cumberland, Chemist.
1912. Wheeler, Thorne L., c/o Edible Products Co., 156—186, East 22nd Street, Bayonne, N.J., U.S.A., Chemist.
1895. Wheelwright, Dr. E. W., 14, Carisbrooke Road, Edgbaston, Birmingham.
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O.M. Whiffen, W. G., Lombard Road, Battersea, London, S.W., Manufacturing Chemist.
1899. Whitaker, Milton C., Columbia University, New York City, U.S.A., Chemist.
1895. Whitaker, Thos., Aire Vale Dye Works, Newlay, near Leeds, Dyer.
O.M. Whitaker, Thorpe, (Journals) Bradford Dyers' Association, Ltd., and 35, Pemberton Drive, Bradford, Yorks, Dyer's Chemist.
1893. White, Arthur F., 2, Melbourne Grove, Thornbury, Bradford, Yorks, Manufacturing Druggist.
1915. White, Gerald N., 15, West End Avenue, Pinner, Middlesex, Research Chemist.
1898. White, Jno., County Offices, St. Mary's Gate, Derby, Public Analyst to County of Derby.
1911. White, John W., c/o E.C. Powder Co., Green Street Green, Dartford, Kent, Works Chemist.
O.M. White, Paul T., Hortonfield House, West Drayton, Chemical Manufacturer
1910. White, P. Winzar, Mayfield, Hayes, Middlesex, Manufacturing Chemist.
1911. White, Walter W., c/o Citro Chemical Co., Maywood, N.J., U.S.A., Secretary and Manager.
1912. Whitehead, Charles E., Devonshire Villas, Barrow Hill, near Chesterfield, Derbyshire, Chemist.
1903. Whitehouse, P. L., 16, Lombard Street, West Bromwich, Staffordshire, Oil Chemist.
1906. Whiteley, C. E., 21, Brudenell View, Leeds, Demonstrator of Chemistry.
1885. Whiteley, R. Lloyd, The Institute, West Bromwich, Staffordshire, Principal.
1892. Whiteside, Jno. L., 376, St. Helen's Road, Bolton-le-Moors, Chemical Lecturer.
1911. Whitley, George, jr., c/o Ridley, Whitley, and Co., Ltd., Angel Road Works, Edmonton, N., Linoleum Manufacturer.
1912. Whitney, Wm. L., c/o U.S. Graphite Co., Saginaw, Mich., U.S.A., Chemist.
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# Canadian Section.

*Meeting held at Montreal on Friday, 16th October, 1914.*

PROF. J. W. BAIN IN THE CHAIR.

## DEVELOPMENT OF CHEMICAL INDUSTRY IN CANADA.

BY T. H. WARDLEWORTH.

The Canadian Section of the Society of Chemical Industry at its opening meeting for the season 1914—15 finds the interests it represents in a position not likely to recur for many a long decade. Supplies of very necessary materials can no longer be secured from their usual sources, and we are compelled not only to look elsewhere for the goods, but to take steps that such a contingency does not arise again, by seeing to what extent we can provide such products in our own country, which is so rich in natural resources.

It would appear, therefore, that our Society is fulfilling its functions in a most pronounced way, when it takes upon itself the task of ascertaining to what extent the chemical industries of the country can best be helped, and as far as possible extended, to meet the needs of the present and the greater demands of the future. We may have to ask our Government to assist us in this work, and we believe we shall have a sympathetic hearing when we present our claims.

No nation has been able to compete against the scientifically managed manufactures of Germany, many of the most important of which were originally instituted in England, France, or the United States. No other country can boast of a single business combination, comprising three firms (the chemical factories of Elberfeld, Ludwigshafen, and Treptow), which employs over seven hundred qualified chemists. And yet, in spite of the unique facilities already afforded by Germany for the prosecution of pure science, further aid has been demanded and granted. The German government has for many years endowed the universities and technical schools—which indeed are under the direct control of the State—with annual sums vastly greater than those applied to similar purposes in England. In addition to this indirect method of furthering the progress of science, a Society for the Promotion of Science has recently been constituted.

The society in question is the Kaiser-Wilhelm Society, which defines in its first statute its primary object: "To promote the sciences, especially by the foundation and support of scientific institutes of research." The income of the society, subscribed by private individuals or by firms, will be devoted to the establishment of institutes of research in which distinguished investigators in the various branches of science will be afforded facilities and means for the prosecution of their chosen problems.

In prosperous times, the Canadian manufacturer thinks that he has no need of scientific assistance: in times of bad trade he believes that he cannot afford it.

As a country Canada is blessed with manifold natural advantages—our mines give us arsenic, antimony, cobalt, nickel, copper, platinum, osmiridium, gold, phosphates, magnesite, silver, chromium, tungsten, molybdenum, barytes, mica, graphite, asbestos, lime, salt, shale, and coal. There is no reason why many of the metals should not be refined in Canada. Why should all our crude nickel go abroad to be purified? Why should we not make our own copper sulphate—hundreds of tons of which are imported every year? Phosphatic rock with all its possibilities is to be found in large quantities within a hundred miles of Montreal. Tons of magnesium carbonate and calcined magnesia are imported every year: yet we have large supplies of the crude material within easy reach of Montreal. There is a very large deposit of fine grade magnesia near Ottawa which is suitable for many purposes, but would be peculiarly adapted for fire-brick were it not for the fact that it lacks a small percentage of iron, a trace practically, and this want constitutes the difference between an excellent fire-brick magnesia and one which is of no value at all. One method suggested is simply to add the iron, but it is stated that large sums of money have been spent in this direction without success. It is a problem for the younger chemists, who will turn our wonderful deposits of magnesite into a commercial proposition of exceeding value if they can only find the missing link. There is an ever-increasing demand for barium peroxide, and while there are large supplies of barytes in Nova Scotia we do not produce an ounce of the peroxide, bringing it all from England and Germany. Graphite is to be found here, and as the price of pencils is likely to be advanced, would it not be worth while to pay attention to the compounding of graphite for making pencils? If we are successful we may be sure our wood workers would do the rest. Why should our phosphorus go abroad and come back in the form of phosphoric acid, the various phosphates, phosphides, and hypophosphites, at enormously enhanced prices? In Nova Scotia, it is said there are enormous deposits of shale, now the subject of financial development. Instead of shipping the shale, why should we not make the finished products? It is true that we are doing something practical with our salt deposits, but it seems to me that our enormous imports of bleach ought to suggest a great extension of this work.

Turning to wood products, we now make wood alcohol, acetone, acetic acid, acetates of lime and soda, and formaldehyde. Why cannot we make also glacial acetic acid? We produce the 80% acid, but import the 99%.

In some directions we are doing well—the calcium carbide industry is well established, and we are beginning to supply the world, thanks to our supplies of raw materials, our magnificent water powers, and the initiative and energy of the manufacturers. The same company is about to produce ferro-silicon, and it will be on the market at an early date. We may expect cyanamide and probably other products from atmospheric nitrogen in the near future.

We also produce, and produce well, commercial sulphuric, hydrochloric, and nitric acids, but we do not make as much use of this fact as we might in other branches of chemical industry by the production of resulting compounds.

Glycerin we now refine in two centres, Montreal and Toronto, and excellent results are given by both factories.

Ethyl alcohol is also produced in this country—a fact appreciated by many of our members—but it seems to me that it is our duty to ask the Government for the privilege of free alcohol for technical purposes. It is said that the refusal of the British Government to give permission for the use of free alcohol to the infant aniline industry was the main cause of its decline and transfer to Germany. I have been informed that the Government is in many respects favourable to duty-free alcohol for chemical manufactures, but those who apply to the Government will have to be very explicit in their reasons for wanting duty-free alcohol. Would it not be possible, while dealing with this question, to know more of the development of ethyl alcohol from sawdust? Under the

head of alcohol, would it not be within reason to ask the Government to make arrangements whereby manufacturers in this country could use the fusel oil, most of which is now sent to the States and comes back to us as "banana oil," so largely used by the bronze paint people, and also as amyl acetate?

We are as a country very short of potash as a product. In the past we used to produce a large quantity of potassium carbonate, but this seems to have fallen off considerably of late years, due probably to the fact that so much of the country has been cleared that there is not now the same opportunity of collecting the ashes as in the old days. At the same time we have recently heard of a process for getting potash from sawdust, but as the yield is only about 3%, it is to be feared that the process would not be profitable. The utilisation of sawdust as a basis for the manufacture of either potash or oxalic acid might be seriously considered, as we have abundant supplies of raw material, which at the present time constitutes nothing but an annoying problem to the producers. Another source of potash available to us at the present time is felspar. We believe there are large deposits of felspar in the neighbourhood of Kingston, containing about 18% of potash, and the problem is to extract this on a satisfactory basis. I have recently come in contact with another process which appears to be successful. Although dealing with a very much higher class of material which comes from somewhere down the St. Lawrence, still in my opinion it shows that the problem may be solved. There is also the prospect of potash deposits being found in British Columbia.

Carbolic acid is being produced in different parts of the Dominion, but so far as we can learn there is no evidence of the production of the finer grades, or of efforts to produce absolute phenol, and it would appear that this is a field which might be cultivated with advantage, because we have very large supplies of raw material and the demand for carbolic acid in the Dominion is very considerable. The making of the finer grades of phenol is a delicate operation, but we hope that in the near future we shall have offered to us crystallized carbolic acid of good quality of Canadian manufacture.

The paper industry seems to be well covered by the chemists, but I think the manufacturers could devote some attention to parchment paper in all its forms. We import enormous quantities of this article from Europe. As we have the primary materials here in such abundance, it should be possible for us to produce on the spot parchment paper equal to any in the world.

Ammonia is produced in large quantities and of excellent quality in the Dominion, but, so far, we do not seem to have succeeded in making the carbonate to compete with either the American or the English, and this is a point which I think might be taken up with advantage by our Canadian chemists, as we import large quantities of this particular article.

Allied to the production of ammonia is the naphthalene industry, and so far we have been able to produce a grade of flake naphthalene which compares favourably with the English and American products, but it is open to some objections which affect its sale to the general public, in any large measure. But the manufacturers hope at an early date to produce not only flake but ball naphthalene as well, of an improved quality.

I have outlined some of the lines on which the energies of our chemists may be directed for the development of the chemical industry in Canada, and I feel sure that we are capable in Canada of very largely extending the area of our usefulness in the domain of chemistry. We must look to the Government and our richer citizens for assistance to foster research, as I am convinced that a great deal of the value of the future work will depend largely upon research carried on to-day by our master-thinkers in Canada. We should depend not too much upon the illusive prospects held out by the abrogation of patents or anything of that kind, but rather should we look to our younger chemists to throw themselves into the fields of earnest work for the improvement of old processes and development of new ones.

I feel confident that, as we are the followers of men who have made the forests of Canada ring with their axe and have not been dismayed by the obstacles opposed to them, we shall have the opportunity and the will to exercise our talents and our energy for the building up of a greater, a richer, and a constantly progressive chemical industry worthy of the growing Dominion of Canada.

## Discussion.

Mr. Herbert J. S. Dennison wrote as follows:—

The chemical industry is one which will probably be more closely affected than any other by the present war, as Germany in particular is noted for its activity in the chemical sciences and there are probably many patents on valuable chemical products and processes which may come within the scope of some of your members. The value of patent rights as an incentive to persons or firms developing the various arts is not generally realised, but the British Government passed an Act shortly after the declaration of War whereby the British Board of Trade was empowered to order the avoidance or suspension in whole or in part of any patent, design, or trade mark or of any license under such held by a subject of any state at war with His Majesty.

The Canadian Government followed suit, but the Canada War Measures Act of 1914 only relates to patents. These Acts have been very much misquoted and misunderstood in that these patents are not thrown open to the public generally, but the Commissioner of Patents is empowered to order the avoidance or suspension of any patent or license thereunder owned by a subject of a state at war with His Majesty, and he may grant a license to anyone applying therefor upon such terms and conditions as he may think fit, but he may require the applicant to show a *bona fide* intent to manufacture or operate under the patent and that the granting of such license will be in the general interests of the country or of a section of the community or of the trade. It is also provided that if a person, during the period of such avoidance or suspension should have made application for and obtained a license, begins to manufacture, use or sell the patented invention or to operate under a patented process, such person may continue to so manufacture or operate the invention without interference and without having to account to the original owners of the patents.

It is within the power of the Commissioner of Patents to grant one or more licenses, but he may at his absolute discretion revoke the order of avoidance or suspension and further refuse later applicants on the ground that the public is already being served by license already granted. In this manner manufacturers desiring to utilise a special process, which will require a considerable outlay of money or experiment, may be assured an exclusive license, or at least limitations in the granting to others.

In regard to foreign patents, Canadians owning patents in any of the belligerent or neutral countries may rest assured that these will be maintained in full force and effect, even in Germany or Austria, as the British Government has issued

a license under which members of the Chartered Institute of Patent Agents in London may pay any fees necessary for obtaining the grant or for obtaining the renewal of patents or the registration of designs or trade marks or renewal of such registration in an enemy country. Existing patents may thus be kept in full force and effect or new applications filed which under the various international laws must be filed within certain clearly defined periods following the filing in the home countries.

Mr. MILLS said that the reason why Canada did not produce chemicals was largely due to lack of knowledge. Canadian markets for chemicals were not so large as those of other countries, and consequently Canada could not produce on the same scale as Germany. On the other hand many chemicals were very high in price because they were brought from long distances. Therefore, while the demand in Canada was not big enough to start many industries, yet it should eventually be profitable to develop some lines on a small scale. It would not be wise to attempt industries which necessitated raw materials not easily obtained in Canada, for instance the dye industry, but a number of small things could be manufactured in Canada, and should be attempted at once. The raw materials produced in Canada were the basic ones, and this was unfortunate in one sense, because it meant that the quantities handled had to be fairly large; against that must be put the advantage of having the raw material on the spot. Silver nitrate had already been made in Canada, and there were many other things of a like nature. Canada had imported many things from Germany merely because they were easily obtained and not because they could not be made in Canada.

Mr. THOMS said that oxalic acid should have been made from sawdust in Canada long ago. No country had more sawdust than Canada, and caustic soda was also plentiful. The great bulk of the oxalic acid used in Canada came from Germany and was made synthetically. Before the war the price had been $6.00 per cwt., but almost immediately it had risen to $23.00.

Very little silver nitrate was imported because Canada was one of the largest producers of silver in the world, and the nitrate was very easily made. Regarding the alcohol question, the duty the Government had demanded was $1.90 per proof gallon, and $2.40 including war tax. Manufacturers of ether and chloroform in the U.S.A., where they had duty-free alcohol, had a cheap alcohol of sufficient purity to allow them to make ether and chloroform and sell it in Canada at a price lower than the cost of the necessary alcohol alone.

Mr. GOODWIN suggested that the sawdust might be used in making dolls, which had to be painted; paraffin wax was used to make the faces. There were in Canada unusual possibilities in the supply of the rare elements, such as molybdenum. Was there any reason why they should not manufacture the iron alloys and other products based, for example, on molybdenite, sufficient for their own needs, and probably a large quantity for the United States? The attempt to manufacture potash from felspar at Kingston had not been very promising up to the present; but under conditions such as now existed it would bring some of the processes within reach of a margin of profit. Whether conditions would continue for long enough to give them a good start was the problem. They had been trying at Kingston, with good prospects of success, to make the potash contents of felspar available for agricultural purposes without extracting it from the felspar. Government assistance in efforts to extend manufactures might be dangerous in some ways. For instance, the German Government, in order to stimulate beet sugar manufacture in Germany, had given considerable rebate upon all sugar exported. Large manufacturers had sold their sugar in foreign markets at a lower rate than in home markets. Germany also exported great quantities of fruit which Great Britain had made into jams and exported back, and undersold the Germans in their own markets.

Mr. MILLAR said that they could not hope to make copper sulphate, the larger part of which came from the copper refineries in the United States. It was a by-product of the tank liquor, and could be bought for barely the price of the copper it contained. Hydroquinone could be produced fairly cheaply. It had risen from $1.00 a pound to $4-5.00 a pound. The trouble seemed to be that the gas companies did not make the same use of their tar products as was done in Germany.

Mr. G. W CHADSEY said that it was a tremendous problem to undertake the manufacture of any materials which had involved a great deal of research. They could not expect to go into the market against the Germans without some of their experience. One way was to start on easy things and work up.

Mr. B. L. EMSLIE said that patents in regard to felspar as a source of potash had been numerous, but none of them had been really successful. The first one granted was in about 1860. The U.S. Government had appropriated a sum annually to be expended in the exploitation of the actual solution of the potash, so far with very little success. One source of potash was the kelp on the Pacific Coast, but the amount was small and in any case could not compete with the German product. A process had lately been introduced at Kingston as a result of which it was said that a 50% article would be sold at $50.00 a ton. It was questionable if it would be profitable to erect an expensive plant, because as soon as the war was over the German product would come in again and it would be impossible to compete with it. Wood ashes had been quoted as a possible solution, and were extensively used. These might be got from sawdust, which contained potash up to 3% of the ashes. Good hardwood had reached 5%, sometimes more, but the average was certainly lower. Just before the war a deposit had been reported near Sussex, N.B., but a sample of drillings had shown only a slight trace of potash in it. Recently it had been stated that further operations had revealed carnallite. On investigation they had found that there had been no further operations, but a German Potash Company believed that those deposits had been formed much in the same way as the German deposits: tidal waves had come in from the Bay of Fundy and evaporated in a dry climate. Alunite used as a fertiliser in a mixture with carnotite had been very successful, and had given results fully equal to German salts.

Mr. SOUTHWORTH said that the cobalt business had been a very close secret for many years. A process leading to cobalt oxide had been worked out at Queen's College and put in operation at their own plant and the Coniagas reduction works at Thorold. There were many complications. The ore contained among other metals, cobalt, nickel, silver, and arsenic. A good many of the chemicals they were now using were manufactured in Canada, but cyanide was not. They were manufacturing a number of products, particularly cobalt oxide and cobalt metal, and nickel oxide and nickel metal.

Mr. E. H. WOODWORTH said that the Canadian Kodak Company was now putting metol on the market, calling it "Elon," and were supplying

part of their own requirements. That had lowered the price in Canada and the United States very materially. Hydroquinone was being manufactured in the States and could now be obtained in any quantity. The cellulose acetate film was still being used, but was likely to be discarded in favour of another non-inflammable film. Eight tons of silver nitrate were used in Canada each year.

Mr. A. NIEGHORN said that if a manufacture was carried on in Canada under German Patents when the terms of peace were arranged, the original manufacturer holding a patent would undoubtedly be allowed again to enter into competition with the manufacturer in a British Colony who had obtained a partial patent. That was only fair. That could be overcome by prohibiting the importation of the article or by protection. It was peculiar that in Canada the imports totalled nearly three hundred million dollars worth more than exports. The duty on chemicals, dyes, and medicines averaged under 6% of our total imports, while the general tariff for the two last fiscal years was something over 16½%. There seemed, therefore, room for some protection to be given to their young chemical industries. There were physical difficulties in the way of manufacturing some things. For instance, molybdenite was mined in Canada and dredged at tide-water in Florida. The Government could not protect them sufficiently to overcome that. There was room for the manufacture of several chemicals in a small way, but some assistance in the way of protection by the Government might be necessary.

Mr. JAS. TURNER said that the reasons why England had not been prominent in the dye industry were due to non-support of the Government and of the capitalist. There was unlimited capital to be had for the dye industry to-day, and the Government had taken the matter up. In future England would be one of the largest producers of aniline dyestuffs and pharmaceutical products in the world. They had made α- and β-naphthol, H and G acids, and such things, but had not manufactured a great variety because the Germans had dumped their large surplus into England the same as sugar. Furthermore, in such things as nitrite of soda they could not compete, as the Germans made it by the lead process, and the English process was by sulphur. The litharge and other German by-products had made it impossible to compete. The plant where they were making β-naphthol, α-naphthol, H and G acids, and Clève acid ought in 6—12 months to be able to supply enough dyestuffs for England and the Colonies, but there were some products which could not be made on account of complicated patents. The duty on ethyl alcohol and methyl alcohol had been a hindrance to the colour industry for a long time, but when free alcohol had been obtainable they had put down one of the largest plants in the world for making dimethylaniline, Methyl Violet, Malachite Greens, etc. They could produce as much basic colours as any German manufacturer. If such a plant were started in Canada it would mean not only a plant for manufacturing dyes, but allied manufactures, such as a distillation plant for coal tar. The processes were elaborate and the consumption in Canada would not warrant any manufacturer putting down such a plant. But some things could be manufactured with profit: benzol and nitrobenzol for instance.

Mr. R. W. BREADNER said that so far as he was aware, no bonuses were being granted in Germany on sugar, nor did the granting of bonuses ruin British refineries. In Canada raw sugar was not entitled to entry under the preferential tariff at the British preferential rate unless produced on British territory, and imported direct, and refined sugar was not entitled to the preferential rate unless it was made from raw sugar produced on British territory.

Mr. T. H. WARDLEWORTH said that the history of the sugar question only went back about 100 years, as regards bounties. These had been instituted by Napoleon, and as a result the beet sugar manufacture was developed, bounties having been given until some ten years ago by Germany, Belgium, Russia, and France under convention. A few years ago that convention had broken up, and there was no bounty system to-day. Whatever the result of that may have been to the making of jams in England, to-day England commanded the markets of the entire world in confectionery, chocolate, and boiled sugars. From the refuse of the sugar beet was produced one of the finest carbonates of potash, 99·9%, and far more suitable than any other when a pure article was required; it might be made in Canada shortly. Canadian producers of silver could not produce metal good enough to make really good nitrate without a good deal of trouble. Some refineries left in it a trace of copper which necessitated re-working again and again. They also left bismuth and traces of other metals. What was wanted in Canada was to develop existing industries and resources, and it was better to ask not for protection in the way of duty so much as help from the Government in industrial research work. The Government should work through colleges and institutions. There seemed to be a want of co-ordination between the Government and educational institutions, and a want of co-ordination between the technical chemist and the manufacturer.

## London Section.

*Meeting held at Burlington House, on Monday, December 7th, 1914.*

PROF. W. R. HODGKINSON IN THE CHAIR.

### ON THE REDUCTION OF THE OXIDES OF ANTIMONY AND BISMUTH BY THEIR SULPHIDES.

BY W. R. SCHOELLER, PH.D.

Self-reduction, or the liberation of a metal by interaction of its oxide and sulphide with simultaneous evolution of sulphur dioxide, has been applied extensively in the metallurgy of lead and copper. All the available information concerning the behaviour of other metals under the same conditions appears to be confined to iron and antimony. Ferric oxide reacts with ferrous sulphide and produces ferroso-ferric oxide (this J., 1913, 1111); and since the two former are products of the action of heat and air on pyrites, their interaction provides a simple explanation of the presence of magnetic oxide of iron in copper mattes and roasted pyritic ores (this J., 1913, 738). Antimonious oxide and sulphide are invariably stated to fuse together without decomposition, forming "antimony-glass"; on the other hand, according to an isolated statement* which I have been unable to trace to its original source, a process based on the reaction between antimony tetroxide and sulphide is used "in some places" for the production of metal; while Schnabel† states that the

* Bloxam, Chemistry, Inorganic and Organic, 10th Edition, 476
† Schnabel-Louis, Handbook of Metallurgy, Vol. II., 433.

tetroxide and sulphide when fused together yield antimony-glass. In a previous paper on the composition of liquated sulphide of antimony (this J., 1914, 169), I have shown that the latter contained a certain proportion of uncombined metal besides a considerable quantity of trioxide, from which it was inferred that self-reduction had taken place to a small extent while the material was in a fused condition.

In view of these apparently conflicting statements, I have thought it desirable to ascertain whether the formation of antimony by the interaction of the sulphide and oxide is possible, and the experimental evidence given below proves this to be the case, but only under certain conditions which will be described later. The following facts have been established in the course of this research (the figures in brackets refer to the numbers of the experiments):

Antimony tetroxide containing one atom of "active" oxygen: $Sb_2O_4=Sb_2O_3+O$, reacts with the sulphide just below the fusion-point of the mixture: sulphur dioxide is given off in proportion to the quantity of tetroxide present, and the fused mass which results contains trioxide and sulphide (2; 4). It follows, then, that the course of subsequent self-reduction is independent of the nature of the oxide originally present. The following equations illustrate this point:—

$$\left.\begin{array}{l} Sb_2O_3+2Sb_2S_3=3Sb_2S_2O \\ 3Sb_2O_4+7Sb_2S_3=10Sb_2S_2O+SO_2 \end{array}\right. \quad \begin{array}{l} (1) \\ (2) \end{array}$$

$$\left.\begin{array}{l} 2Sb_2O_3+Sb_2S_3=3Sb_2SO_2 \\ 3Sb_2O_4+2Sb_2S_3=5Sb_2SO_2+SO_2 \end{array}\right. \quad \begin{array}{l} (3) \\ (4) \end{array}$$

In either case, the solubility of the resultant product in tartaric acid ($=Sb_2O_3$ content) is the same, whether the trioxide or tetroxide was used. The use of the above formulæ ($Sb_2S_2O$, oxysulphide; $Sb_2SO_2$, "sulphoxide") is not intended to imply that the corresponding compounds are formed in the fusion, as this is quite unlikely; but it is a convenient means of denoting the composition of the two mixtures.

Antimony trioxide and sulphide, fused together in a current of inert gas (*e.g.*, carbon dioxide), yield metallic antimony and sulphur dioxide: $2Sb_2O_3+Sb_2S_3=6Sb+3SO_2$ (or $Sb_2SO_2=2Sb+SO_2$). The reaction takes place in presence of an excess of either oxide or sulphide (10; 11). It begins soon after the fusion-point of the mixture has been passed (5) and becomes rapid at higher temperatures (8), but it is never complete on account of the volatilisation of both sulphide and oxide in the gas current; the highest yield of sulphur dioxide was 50% of the theoretical (9). The extent of the reaction increases with the relative surface of the fused mass exposed to the gas; if the latter be introduced into a Rose crucible, the fusion product contains but little metal (6; 14), whereas the use of a porcelain boat heated in a porcelain tube ensures a maximum yield (7—9). The foregoing remarks also apply to antimony-glass (14; 15). Metallic antimony is not formed if the oxide-sulphide mixture is fused in a crucible under a layer of salt (12; 13). A close analogy is thus established between the conditions affecting self-reduction and the volatility of the metal itself, for the metal volatilises at a bright-red heat in the air, or in a current of a gas, but not when fused under a layer of common salt.* Another example of the volatility of antimony compounds modifying the course of a reaction is quoted from Schnabel†: if antimony tetroxide be ignited with charcoal and alkali carbonates, metallic antimony is obtained; if the alkali be omitted, the greater part of the antimony will be volatilised as trioxide, a small part only being obtained in the metallic state.

The observations recorded above account for the formation of metallic antimony in certain metallurgical operations. First, if stibnite is roasted with insufficient access of air, some oxide will be formed and react with the unaltered sulphide, part of the antimony separating in the metallic state. This is demonstrated in Exp. 16, the two stages of which correspond to those of the Flintshire process of lead smelting, except that in the case of antimony a neutral gas current has to be maintained during the second stage. Secondly, as regards the liquation process, it is now established that self-reduction is the cause of the presence of reguline metal in crude antimony; no doubt the air charged with sulphur dioxide rising from the surface of the molten material plays the part of the gas current which is so important a factor in this reaction. It was ascertained that sulphur dioxide does not reduce antimonious oxide (17); it therefore takes no active part in the liberation of the metal. Thirdly, there is an obvious connection between self-reduction in a gas current and the converting of stibnite. Since writing my last paper I have discovered a previous reference* to the bessemerising of antimony sulphide; the article is merely a short statement to the effect that regulus of antimony may be obtained, together with sublimed sulphide, oxysulphide, or oxide, by blowing air through molten stibnite; no experimental data or details of practical working are added, and the abstract in the "Mineral Industry"†) conveys as much information as the original.

*Bismuth.* Nothing, apparently, has been published regarding the self-reduction of bismuth, which, having a more metallic character and a feebler affinity for oxygen than antimony, might be expected to react similarly to lead. My experiments prove that bismuth sulphide and oxide interact easily either in a current of carbon dioxide (18) or in a crucible under a layer of salt (20). The evolution of sulphur dioxide begins at a very low temperature, and the dark powder soon becomes a mass of tiny grey globules of metallic bismuth, which run together on increasing the heat. According to the equation: $2Bi_2O_3+Bi_2S_3=6Bi+3SO_2$, the yield of metal was 90% of the theoretical (20). The quantity of liberated metal was larger than that of evolved sulphur dioxide, and the non-metallic matter in which the buttons were embedded gave a distinct sulphate reaction, showing that a small proportion of basic bismuth sulphate was formed (19). This may be represented by the equation: $6Bi_2O_3+Bi_2S_3=8Bi+3(BiO)_2SO_4$. The formation of basic sulphate by oxidation of the sulphide and its stability at high temperatures are familiar facts in the metallurgy‡ and analytical chemistry§ of bismuth.

### *Experimental Part.*

The experiments were carried out with pure antimony trioxide (Kahlbaum), tetroxide prepared from it by oxidation with nitric acid and subsequent ignition, and Japanese stibnite in large crystals. The latter is perhaps the purest form of antimony sulphide obtainable; the precipitated sulphide is almost invariably contaminated with chlorine. The mineral was ground to pass an 80-mesh sieve (I.M.M. standard); it assayed Sb 70·76%, insoluble 0·40%, As, *nil*, heavy metals less than 0·1%. Though crude antimony contains oxide and metal, it was used in experiments 13—15, together with a rich cervantite ore.

* Roscoe and Schorlemmer, Treatise on Chemistry, 1907, Vol. II., 943.

† Schnabel-Louis, *loc. cit.*, 433.

* A. Germot, Revue des Produits Chimiques, 1907, **10**, 375.

† Mineral Industry during 1907, **16**, 53.

‡ Schnabel-Louis, *loc. cit.*, Vol. II., 351.

§ Low, Technical Methods of Ore Analysis, 5th Edition, 1911, 53.

Table I. shows the results of four experiments in which a porcelain boat containing mixtures of sulphide and trioxide or tetroxide was heated in a glass tube in a current of dry carbon dioxide; the escaping gas was passed through iodine solution to oxidise the sulphur dioxide, which was estimated in the usual manner. The contents of the boat were heated with a Bunsen burner until just fused, and left to cool under carbon dioxide. The fusion products were ground, and boiled with 5% tartaric acid solution for 30 minutes; the filtrates were made alkaline with bicarbonate and titrated with iodine: this gives the amount of $Sb_2O_3$ in the material. The sulphur evolved as dioxide is given in per cent. of the total quantity present in the stibnite. The molecular proportions correspond to equations 1—4 quoted above.

TABLE I.

| Exp. No. | Molecular proportion. | S evolved as $SO_2$ | | $Sb_2O_3$ in fusion product. | |
|---|---|---|---|---|---|
| | | Found. | Calculated. | Found. | Calculated. |
| 1 | $Sb_2O_3+2Sb_2S_3$ | 0·12% | 0 | 39·4% | 39·0% |
| 2 | $3Sb_2O_4+7Sb_2S_3$ | 5·71% | 4·76% | 32·0% | |
| 3 | $2Sb_2O+Sb_2S_3$ | 0·05% | 0 | 63·2% | 65·1% |
| 4 | $3Sb_2O_4+2Sb_2S_3$ | 20·93% | 16·67% | 64·8% | |

Exp. 5. The products obtained in the preceding experiments had the appearance and softness of stibnite. Nos. 3 and 4 were again fused in the same manner, but a higher temperature was maintained for 15 minutes, during which time sulphur dioxide was slowly evolved; the products after cooling were scoriaceous and iridescent, and showed a considerable increase in hardness. The tests were interrupted as the glass tubes bulged and broke.

Exp. 6. A glazed Rose crucible was now used so as to work at higher temperature in a current of carbon dioxide. 3·366 grms. $Sb_2S_3$ (2 mols.) and 4·566 grms. $Sb_2O_4$ (3 mols.) were fused with the full heat of a large Bunsen burner for 1 hour. The resultant product consisted of brown antimony-glass, in which was found a white metallic globule of crystalline fracture, weighing 0·0258 grm. and assaying 98·9% Sb. (Compare Exp. 14.)

In the experiments summarised in Table II. a porcelain tube containing the porcelain boat was heated in a short combustion furnace. Arrangements for passing dry carbon dioxide and absorbing the sulphur dioxide were the same as in Exp. 1—4. The direct determination of the metallic antimony formed in these tests being impossible, the amount of sulphur dioxide evolved was taken as the measure of the degree of self-reduction.

TABLE II.

| Exp. No. | Molecular proportion. | S evolved as $SO_2$ = Degree of self-reduction. |
|---|---|---|
| 7 | $2Sb_2O_3+Sb_2S_3$ | 21·0% |
| 8 | $2Sb_2O_3+Sb_2S_3$ | 41·6% |
| 9 | $2Sb_2O_3+Sb_2S_3$ | 49·7% |

Exp. 7 was interrupted before the reaction was complete, as a fairly large quantity of mixture was taken in order to obtain enough pure metal for an antimony determination: the $SO_2$-figure is therefore low. The metallic buttons were detached from the boat, and cleaned from adhering sulphide, etc.; they assayed 97·8% Sb.

In Exp. 8 a thermo-couple was introduced. The temperature was slowly raised, and after 40 minutes remained constant at 965° C., where it was kept for half an hour, so as to secure a maximum yield of sulphur dioxide: 41·6% was obtained. The boat was practically empty, except for a film of yellow glass; the sublimate in the cold part of the tube consisted of white metallic globules and a steel-grey crust of sulphide and oxide.

Exp. 9. In the preceding test a 4-in. boat was heated in a 6-in. sectional furnace. Another 6-in. section was now placed behind that containing the boat, but this addition to the heated area did not greatly increase the extent of self-reduction: 49·7% of the total sulphur was evolved as dioxide. Sublimate and residue were the same as in the last experiment.

Exp. 10 and 11. Two mixtures, the first containing an excess of oxide ($5Sb_2O_3+Sb_2S_3$), the other an excess of sulphide ($5Sb_2S_3+Sb_4O_3$), were treated as before in the porcelain tube. In both cases much sulphur dioxide was given off, and globules of regulus formed. By-products were obtained as follows: with excess oxide, a slight residue of orange-red antimony-glass and a sublimate containing white needles of antimonious oxide; with excess sulphide, a residue and globular sublimate of sulphide, easily distinguishable from the metal itself.

Exp. 12. A covered crucible, containing a mixture of sulphide and oxide ($Sb_2S_3+2Sb_4O_3$) under a layer of salt, was heated in a muffle for 45 minutes. The fusion product consisted of red antimony-glass which, except for a slight silicious residue, was completely soluble in hot hydrochloric acid: no regulus could be detected. (See also Exp. 13.)

In the three following experiments, which demonstrate the formation of metal from antimony-glass, crude antimony and an oxidised ore were used. The presence of free metal in the crude did not interfere, as the tetroxide of the cervantite oxidises the antimony, thus: $3Sb_2O_4+2Sb = 4Sb_4O_3$. (Schnabel, p. 433.)

Exp. 13. Two covered crucibles containing the same charge, viz., equal parts of powdered crude and cervantite ore, were heated for 1 hour to about 1000° C. in a muffle; a layer of salt was used in one crucible, borax-glass in the other. In both cases reddish-brown glass was obtained, which was found to be free from metallic antimony.

Exp. 14. The glass obtained in the preceding experiment was fused under carbon dioxide in a Rose crucible for 1 hour, using a Teclu burner. No button was found as in Exp. 6, but on digesting the powdered glass with hot hydrochloric acid, a small quantity of regulus was detected by its characteristic colour and lustre. It may be stated here that antimony sulphide and the metal can be "parted" with hydrochloric acid, and that the latter cannot be mistaken for the former; the separation is not quantitative, as an appreciable amount of regulus dissolves. (This J., 1913, 260. Solubility of Sb in $Sb_2S_3$: this J., 1906, 376.)

Exp. 15. The same glass was again fused in a current of carbon dioxide, this time in the porcelain tube. After 30 minutes' heating, the boat presented a striking appearance: it was full of large, white, metallic beads.

Exp. 16 illustrates the formation of metal from stibnite. The mineral was fused at a gentle heat in a current of air, which converted it into a mixture of sulphide and trioxide, part of the latter escaping as fume. The air was then replaced by a current of carbon dioxide, and the temperature raised to about 950° C. The fusion product contained a considerable proportion of metallic antimony, which was detected by "parting" with hydrochloric acid.

Exp. 17. Antimonious oxide was fused for some time in a current of sulphur dioxide, and the escaping gas passed through barium chloride solution. No decomposition of the oxide was

observed, nor was any barium sulphate obtained in the receiver.

*Bismuth.* The oxide was prepared by ignition of pure bismuth nitrate, and the sulphide by precipitation of the same salt with sodium sulphide. The results of the experiments are shown in Table III.

TABLE III.

| Exp. No. | Molecular proportion $2Bi_2O_3 : Bi_2S_3$. | Metallic Bi. | $SO_2$ evolved. |
|---|---|---|---|
| 18 | Glass tube; $CO_2$ current | not determine | 63·1% |
| 19 | Porcelain tube; $CO_2$ current | 78·1%* | 68·1% |
| 20 | Crucible; salt cover | 87·8%* | not determined |

* Not quite quantitative: see below.

Exp. 18 was made in the apparatus described under antimony, Table I. At a very low temperature the mass darkened and gave off sulphur dioxide without showing any sign of fusion. The experiment was stopped after 10 minutes as the tube commenced to soften; the product after cooling consisted of minute metallic globules cemented together, which disintegrated on digestion with moderately strong hydrochloric acid: this solution was found to contain sulphate.

Exp. 19 corresponds to the high-temperature experiments with antimony, Table II. The porcelain tube was heated for 30 minutes to about 950° C. The porcelain boat was found to contain several large and small buttons of bismuth which were collected and weighed: slight losses occurred in detaching them. A colourless residue, giving sulphate reaction, coated part of the boat.

Exp. 20. A covered glazed Rose crucible containing the oxide-sulphide mixture under a deep layer of salt was heated for 15 minutes over a Teclu burner. Minute globules of metal round the inner edge of the crucible gave evidence of volatilisation, in spite of which the amount of bismuth collected and weighed was 87·8% of the theoretical.

My thanks are due to Messrs. G. T. Holloway and Co., Ltd., for facilities afforded in the experimental work and their permission to publish the results.

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In reply to a question, the author said he had not carried out the reactions on any larger scale than a purely laboratory one.

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## THE REMOVAL OF CARBON BISULPHIDE FROM COAL GAS.

BY E. V. EVANS, F.I.C.

The numerous chemical and physical processes that have from time to time been proposed for the removal of carbon bisulphide from coal gas are briefly described by Witzeck (J. Gasbeleucht., 1903, 21 *et seq.*), whilst the history of the subject, with special reference to processes involving the heating of gas, has been compiled by Dr. Charles Carpenter, and is included in his lecture delivered recently to the Institution of Gas Engineers at Liverpool (see this J., 1914, 737).

The sulphur compounds remaining in coal gas after the extraction of sulphuretted hydrogen consist mainly of carbon bisulphide, and the proportion by volume of this constituent in the gas represents only about 0·02%. Considering the immense volumes of gas to be dealt with in the case of a modern London Gas Works it is obvious that the elimination of this impurity, owing to its state of extreme dilution, should be effected by a chemical reaction of high velocity. The initial stages of a laboratory investigation were therefore directed towards ascertaining the relative intensities of known reactions of carbon bisulphide, provided such reactions entailed the use of reagents suitable for application on the large scale. These may be collectively described under three headings:—

(1) The extraction of carbon bisulphide by alkalis or alkaline earths, in the presence of sulphuretted hydrogen.

(2) The interaction of carbon bisulphide and certain amino compounds, such as aniline, either with or without the use of catalytic agents.

(3) The decomposition of carbon bisulphide by heat, with or without the presence of catalysts.

The "Athion" process which utilizes alkaline cellulose for the extraction of carbon bisulphide from gas previously freed from carbon dioxide is of recent origin and was not examined by the author.

1. *Alkalis and alkaline earths.*—The purification of gas by lime is based on the absorption of carbon bisulphide by an active sulphided compound, with the formation of a thiocarbonate. As thiocarbonates are readily decomposed by carbon dioxide, the extraction of this constituent of the gas is essential. Carbon dioxide, though inevitably produced in the manufacture of gas, is not an impurity, and the necessity of removing it is an impediment to the economic efficiency of any process. When lime is employed to remove carbon dioxide, the cost of raw material alone represents about ½d. per 1000 cubic feet of gas purified, which is more than the total working costs of a process to be described later. It has been stated by Sabatier and others that the major portion of carbon dioxide may be extracted by washing the gas with solutions of potassium carbonate, the resulting bicarbonate being decomposed by heat with regeneration of the carbonate. This reaction is a slow one, and its application on a large scale necessitates the employment of extensive apparatus. It has, further, been proposed to recover, for sale, the carbon dioxide evolved in the regeneration process, but this obviously cannot receive wide application, as the output of a few large works would crush the market.

The nature of the reactions involved in the lime process of gas purification has been demonstrated by Divers and Veley (see this J., 1884, 481, 550; 1885, 633), and the work of these investigators was repeated in the laboratory. Slaked lime yields, by the action of gas containing sulphuretted hydrogen, a sulphided compound capable of arresting carbon bisulphide with the formation of a basic calcium thiocarbonate. The intermediate and final products of this reaction were prepared, and all laboratory operations demonstrated the extreme sensitiveness of the reaction to outside influences. A portion of the intermediate sulphided compound—considered by Divers to be calcium hydroxyhydrosulphide—became oxidised and rendered inactive by oxygen contained in small quantity in the gas, whilst the final product, the basic thiocarbonate, was not only decomposed by carbon dioxide, but was dissociated at slightly increased temperatures. Taking advantage of this instability to the influence of heat, an unsuccessful attempt was made to place the lime process on a more practical basis, by rendering possible the regeneration of spent material *in situ*, and thus to overcome the nuisance associated with spent lime. This scheme proved satisfactory only when utilising pure reagents, and failed completely when applied to the coal gas mixture, owing to the oxidation of active sulphides to sulphites and thiosulphates, which preclude regeneration, and to the difficulty of determining the conditions most favourable to the extraction of carbon bisulphide, and of

completely eliminating the last trace of carbon dioxide from the gas.

The purification of large volumes of gas by a solid is objectionable, unless the reaction involved is of high chemical velocity, and such is not the case in the extraction of carbon bisulphide by lime. Finally, the process as generally adopted entails an enormous loss of sulphuretted hydrogen, which should be worked up into a marketable product.

The use of concentrated ammonia solution for removing carbon bisulphide as a thiocarbonate, was found to be technically impracticable, whilst no advantage could be taken of the reaction, $CS_2 + 4NH_3 = NH_4SCN + (NH_4)_2S$.

2. *Amino compounds.*—Amino compounds of the type of aniline, toluidine, etc., have been employed; solid thioureas or thiocarbanilides being produced by the action of carbon bisulphide, thus, $2C_6H_5NH_2 + CS_2 = (C_6H_5NH)_2CS + H_2S$. The presence of sulphur or oxide of iron as catalyst has been recommended. This reaction presented considerable interest, as thiocarbanilide forms the starting point in the manufacture of indigo by Sandmeyer's reaction, and it was demonstrated after an extended study that this process becomes a financial possibility with such an inexpensive raw material. A potent difficulty, however, existed in the loss of the amino compounds by volatilisation, and the cost of preventing this, by further washing the gas with weak acids or special oils, and of subsequently regenerating the reagent, was considered to be prohibitive.

3. *Decomposition of carbon bisulphide by heat.*—It is well known that if coal gas be heated to about 500° C., most of the sulphur compounds are converted to sulphuretted hydrogen, which may be easily removed by oxide of iron. Vernon Harcourt, whose name stands foremost amongst all investigators of this question, has frequently recommended the application of this reaction to the large scale.

Preliminary work in the laboratory led to the conclusion that of all known reactions of carbon bisulphide, its decomposition by heat in the presence of coal gas possessed the greatest possibilities of technical application, and in 1908 the investigation was directed entirely to this aspect of the question.

Carbon bisulphide is not dissociated into its elements to any appreciable extent by conducting it, in the presence of nitrogen, over contact material heated to 500° C. If, however, hydrogen or coal gas containing hydrogen be used as the gaseous carrier, the velocity of decomposition of carbon bisulphide is greatly accelerated. Under these conditions, moreover, the decomposition of carbon bisulphide is complete and the reaction is not a reversible one.

An experiment was performed in which purified carbon bisulphide was volatilised into a stream of pure hydrogen, at such a rate that the proportion by volume of carbon bisulphide was similar to that existing in coal gas. The gases were passed over heated fireclay which had been previously pulverised and freed from metallic impurities and carbonaceous matter. The rate of flow of the gaseous mixture was so adjusted that the carbon bisulphide was completely decomposed. The quantity of sulphuretted hydrogen evolved was determined, whilst the carbon deposited on the material was computed from the weight of carbon dioxide evolved on combustion. By this means it was proved that decomposition proceeds according to the equation,

$$CS_2 + 2H_2 = 2H_2S + C.$$

To determine the effect of water vapour on the reaction carbon bisulphide was volatilized into a stream of moist hydrogen. Again the reaction proceeded according to the above equation; the quantity of carbon deposited being in molecular proportion to the amount of carbon bisulphide decomposed. Further, carbon dioxide was not present in the final gas mixture and thus the reaction $CS_2 + 2H_2O = 2H_2S + CO_2$ does not take place under these conditions. It was later shown that the presence of water vapour does not increase the case of decomposition of carbon bisulphide at a temperature of 450° C.

Coal gas, freed from sulphuretted hydrogen, was passed over various heated metals reduced to a state of fine division, in order to present a maximum surface area to the gas. Certain metals considerably increased the velocity of decomposition. This property was not a function of the specific heat or conductivity, or of the ease of formation of the sulphide of the metal. Porosity, on the other hand, was found to exert a beneficial effect, but this property in all bodies was rapidly destroyed owing to the deposition of carbon in the pores of the material. Platinum and palladium deposited on pumice, finely divided metals such as iron, nickel, cobalt, and copper, were regarded as catalysts to the reaction, whilst magnesium and aluminium were not superior to contact substances of the type of alumina, pumice, and fireclay. All these bodies, however, became coated with a deposit of finely divided carbon, which could be removed by combustion *in situ*.

Of all metals examined, iron was found to be most active, compatible with low original cost. The significant effect of temperature on the reaction was ascertained, and it was made evident that with the same catalyst, a low temperature and large surface of contact, as well as a high temperature and relatively small contact, were both capable of bringing about the required decomposition of carbon bisulphide. It appeared necessary, for the purpose of reducing to a minimum the size of plant, that the highest temperature that could be suitably maintained on a large scale should be chosen, provided that the illuminating and calorific values of the gas were not altered, and that iron pipes and containers for the catalyst could be conveniently used. From a large number of determinations it was proved that the intrinsic quality of the gas is in no way impaired when operating at temperatures between 150° and 500° C., whilst to establish the second condition—which is indispensable to the technical success of the process—strips of wrought iron were surrounded by waste furnace gas for several weeks at a temperature of 450° C. No destructive effect was visible and the gain in weight was negligible.

Having selected the working temperature, the amount of contact required to effect the maximum decomposition of carbon bisulphide was determined. At a temperature not exceeding 450° C., continuous laboratory experiments were made, using iron turnings as the catalyst and purifying gas at the rate of 10 cb. ft. per hour. By this means 75 to 80 % of the sulphur compounds of gas could be removed. The whole of the carbon bisulphide had disappeared and the residue, representing 7 to 9 grains of sulphur per 100 cb. ft. of gas, consisted mainly of thiophen. From the experimental data obtained in the laboratory a cast iron retort was erected at a small works of the South Metropolitan Gas Company to deal with 50,000 cb. ft. per hour (Fig. 1). Here the greatest mistake was made; the leap from 10 cubic ft. to 50,000 cubic ft. per hour was disastrous. Although the surface of contact between the gas and iron had been proportionately reproduced from the laboratory scale, and a tubular heat interchanger had been installed to recover waste heat from the treated gas, the cooling effect of this large volume of gas upon the catalyst was such that, even when maintaining the retort externally at a low

red heat, practically no reduction of sulphur compounds was accomplished.

In transferring laboratory conditions to the large scale in the case of reactions involving considerable expenditure of heat, there is a liability to overlook the fact that the laboratory furnace is usually out of all proportion to that which may be economically reproduced on the large scale.

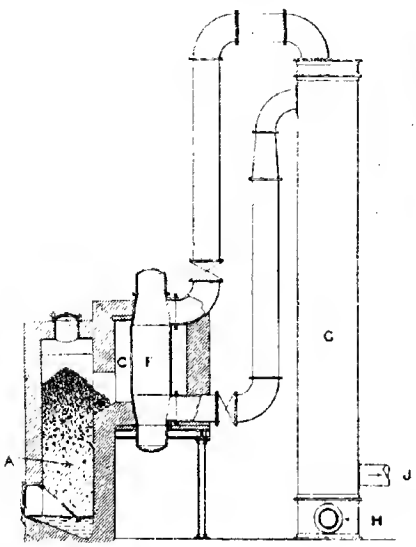


FIG. 1.

A Furnace.
C Heating Chamber.
F Cast Iron Retort.
G Heat Interchanger.
H Gas before treatment.
J Gas after treatment.

The most valuable experience gained with this apparatus was when attempting to aerate the apparently spent material. This operation was found to be quite unmanageable on the large scale, and not only was the catalytic material fused, but a hole was made in the side of the retort where the chemical action of revivification by combustion was most intense. Laboratory experiments confirmed the difficulty of aerating without danger, and the idea of employing a metal catalyst, as such, was abandoned.

It was, therefore, proposed to impregnate a porous body with the catalyst, as, during the aeration, the particles undergoing change would be divided and intense local chemical action would be prevented. Other investigators have recommended the use of porous impregnated material, but it is not recorded that this device has been adopted as a means of rendering manageable the aeration process.

It was expected that impregnated material would require more intimate contact with the gas than metallic substances, but in the case of iron oxide deposited on a porous nucleus, so large was the contact required as to necessitate the search for a more active catalyst. The object of an investigation into a large number of contact and catalytic substances was to choose the material that would require the lowest temperature for the reaction, that would remain active as long as possible, and when requiring aeration, should allow of this being easily effected. Necessarily, in examining all these properties, the initial cost of the material was taken into consideration. The most active of all catalysts was found to be highly porous fireclay, impregnated with nickel, reduced from the chloride. From this work also, it was made evident that the higher the temperature employed, the greater is the quantity of carbon deposited on the material, and the more frequent becomes the necessity for aeration.

There is a tendency of decomposing unsaturated hydrocarbons of the gas, but the quantity decomposed even at 600° C. is insufficient to exert a definite reduction in the quality of the gas. The inconvenience caused by the deposition of carbon on the catalyst presents a greater difficulty, and to obviate this it becomes imperative to reproduce the reaction at the minimum working temperature.

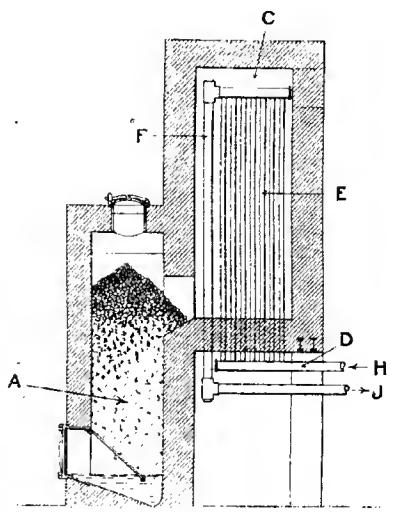


FIG. 2.

A Furnace.
C Heating Chamber.
D Collector Tube.
E Preheating Tubes.
F Reaction Tube.
H Gas before treatment.
J Gas after treatment.

It will serve no useful purpose to describe several further unsuccessful attempts to reproduce the laboratory conditions and results on a large scale. The determination, either by experiment or calculation, of the following salient points led to the design of a system of pipes (Fig. 2) in which the reaction was successfully reproduced:—

(1) The degree of preheating the gas before contact with the catalytic material. The temperature of the gas should be raised to that of the reaction before coming in contact with the catalyst. By this means only is the full value of the catalyst realised. With inefficient preheating the catalyst is cooled by the gas, and former experience shows that in order to bring about the required chemical action, the investigator is tempted to increase the degree of heat around the container of the catalyst, with disastrous results to the iron vessel.

(2) The surface area of catalytic material exposed per unit volume of gas passed.

(3) The porosity, specific heat, and thermal conductivity of the porous carrier of the catalyst.

(4) The volume of free space allowed between the contact surfaces, which determines the absolute velocity of the gas molecules about the catalytic material.

(5) The surface area of the reaction and preheating vessels exposed to the heat of the furnace together with the thickness and thermal conductivity of the material of which the vessels are made.

The system of tubes (Fig. 2) consists of one 6-inch reaction tube containing the catalyst, and so many preheating tubes of 2 inches diameter as to bring the temperature of the untreated gas to within 50° C. of the reaction temperature. This apparatus was capable of dealing with 2,000 cb. ft. of gas hourly, and formed the basis of design of two large scale plants: one erected in 1911 to deal with 2 million cb. ft. of gas per day, and one in 1913 to deal with 10 million per day. The latter installation has been in constant operation for almost two years, yielding an average reduction of 80% of the sulphur compounds of the gas treated therein.

The general principle of this apparatus is shown in Fig. 3. Four 6-inch diameter reaction tubes are connected together in parallel and are supplied by gas previously conducted through horizontal 2-inch preheating tubes erected at the back end of the heating chamber. Each set, as illustrated, is capable of dealing with about 5,000 cubic feet of gas hourly, and thus sixteen sets placed within a furnace constitutes a plant capable of purifying two million cubic feet of gas per day.

The characteristics of gas before and after treatment by this process are shown in the following table:—

| | Before treatment. | After treatment. |
|---|---|---|
| Illuminating power, candles | 14·7 | 14·7 |
| Calorific power, gross B.Th.U. | 500·0 | 504·4 |
| Sulphur, Grains per 100 cb. ft. | 35·07 | 7·52 |
| Naphthalene " " " " | 5·54 | 4·71 |
| Hydrocyanic acid " " " " | 22·10 | 18·75 |
| Analysis— | | |
| $CO_2$ % by vol. | 1·44 | 1·45 |
| $C_nH_m$ % " | 3·55 | 3·63 |
| $O_2$ % " | 0·33 | 0·06 |
| CO % " | 8·16 | 8·03 |
| $CH_4$ % " | 26·85 | 27·26 |
| $H_2$ % " | 54·10 | 54·25 |
| $N_2$ % " (by difference) | 5·48 | 5·32 |

Ammonia is to be detected in gas leaving the plant, and arises from the hydrolysis of hydrocyanic acid. Although the quantity of ammonia evolved is too small to represent a financial asset, it serves a useful purpose in maintaining strongly alkaline the iron oxide used to remove the sulphuretted hydrogen formed by the decomposition of carbon bisulphide.

Practically the whole of the oxygen contained in the gas is removed by this process, but the volume of gas before and after treatment remains unaltered.

There is a tendency to a slight increase in the methane content of gas, but this process should not be compared with the more delicate one of the synthesis of methane by reduced nickel, which requires considerably more contact, and is influenced by "poisons"; the most pernicious of which is sulphur. The decomposition of carbon bisulphide by heat in the presence of hydrogen is a simple reaction which takes place normally by passing the gases over a heated contact substance; the temperature required for decomposition is, however, lowered by the presence of a catalyst (and notably by reduced nickel) which allows the reaction to be performed in closed iron vessels.

The catalytic material of the sulphur process consists of a mixture of reduced nickel with a small quantity of nickel sulphide; the quantity of the latter, at a constant temperature, being a function of the relative proportion of sulphuretted hydrogen and hydrogen existing in the gas at the moment of arresting the reaction.

Experimental Plant for 2 Mill. cb. Cubic Feet.

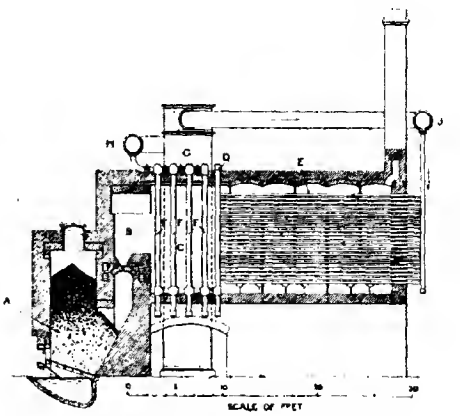


Fig. 3.—Longitudinal Section.

- **A** Furnace.
- **B** Combustion Chamber.
- **C** Heating Chamber.
- **D** Collector Tube.
- **E** Preheating Tubes.
- **F** Tubes containing Catalyst.
- **G** Heat Interchangers.
- **H** Gas after treatment.
- **J** Gas before treatment.

The presence of sulphuretted hydrogen in the gas before treatment decreases the efficiency of the process, which cannot therefore be advantageously applied to crude gas. It would appear that carbon oxysulphide is produced by conducting gas containing carbon monoxide and sulphuretted hydrogen over the heated catalyst. In the laboratory the following reactions have been found to take place under conditions similar to those existing on the large scale:—

$$H_2S \rightleftarrows H_2 + S. \qquad CO + S \rightleftarrows COS.$$

Both reactions are reversible, and the formation of carbon oxysulphide only becomes appreciable when the quantity of sulphuretted hydrogen in the gas exceeds 100 grains per 100 cb. ft. Carbon oxysulphide is decomposed by water according to the equation, $COS + H_2O = CO_2 + H_2S$, but this reaction is a slow one and the removal of this sulphur compound from the gas is difficult.

The question of the possibility of forming nickel carbonyl in this process has received careful consideration. Numerous qualitative tests have been applied to the treated gas, but all attempts to detect nickel have failed. Nickel carbonyl is not produced even when the working temperature is reduced to 250° C., but the precaution is taken to prohibit the contact of gas and the catalyst at temperatures below 300° C.

In the early part of 1914 a large installation capable of dealing with 15 million cb. ft. of gas per day was put to work at East Greenwich. The design embodied an improvement which originated by observing the distribution of heat in an earlier installation, and aimed at reducing the initial cost of the plant. In this plant the 2-inch preheating pipes have been effectually replaced by tubular heat-interchangers erected outside the furnace setting. The East Greenwich plant is divided into five 3-million units. (See Fig. 4.) Each unit consists of a central producer surmounted by a combustion chamber, situated on both sides of

which are heating chambers, maintained at 420° to 440° C. and in which are assembled the 6-inch reaction tubes. The gas is preheated to a small extent within the heating chamber, but mainly by tubular heat-interchangers, in which the treated gas flows in an opposite direction to that requiring

## Discussion.

The Chairman said that the process was another triumph for the catalytic action of nickel. He thought it was the most interesting catalytic process yet discovered. He asked whether the nickel chloride was specially reduced beforehand.

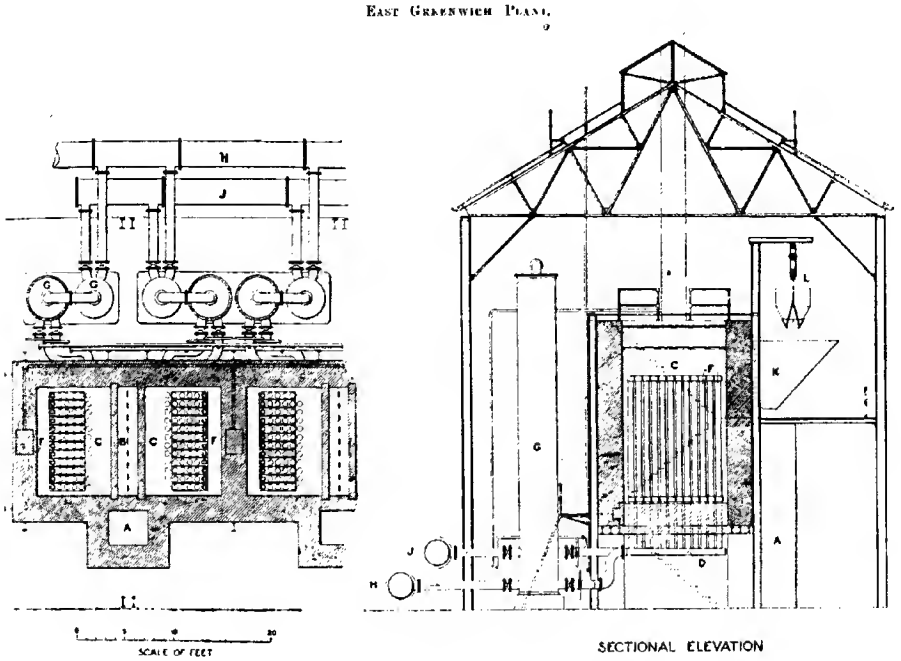


Fig. 4.

A Furnace. B Combustion Chamber. C Heating Chamber. D Collector Tube.
F Tubes containing Catalyst. G Heat Interchangers. H Gas before treatment.
J Gas after treatment. K Coke Hopper. L Coke Handling Plant.

treatment. In order to revivify the material of any one unit, the chamber temperature is lowered, and air is pumped at a definite rate through the reaction tubes. The process occupies about one week, and for the first four days the whole of the oxygen of the air is utilised and replaced by carbon dioxide. When oxygen appears in the effluent gas, the temperature of the chamber is raised to 430° C. and is maintained thus until carbon dioxide ceases to be evolved and the process is complete. When preparing for aeration, or restarting after aeration, gas or air, as the case may be, is displaced from the plant by inert waste furnace gases. The catalyst maintains its activity for about 30 to 35 days, after which period the efficiency of the reaction gradually decreases. Its "original" activity is, however, immediately restored by the process of aeration. After having been in operation for two years, the catalytic material shows no signs of deterioration.

The capital outlay for plant per million cb. ft. of gas per day is £1,500, whilst the working costs entailed in operating the process represent 0·3d. per 1000 cb. ft. of gas; this latter figure includes interest on capital, depreciation, and repair and maintenance.

Throughout this research advice and encouragement have been continuously given to the author by Dr. Charles Carpenter, but for whose guidance this investigation would not have attained a successful issue.

Mr. Evans said it was specially reduced by hydrogen beforehand.

Mr. J. W. Hinchley asked whether the lagging was removed from one of the heat interchangers of each unit to obtain a cooler gas on exit; if so, it would appear that the coefficient of heat transfer adopted in designing was too low. Heat interchange between gas and gas was not a common operation, and it would be useful to know the actual coefficient obtained in this interesting process.

Dr. H. G. Colman said that one of the most interesting chemical points of the process was that nickel could be successfully employed as a catalyst without becoming "poisoned." This would not have been predicted *a priori*, for in the attempts to produce methane commercially from carbon monoxide and hydrogen by heating at 250—300° C. in presence of nickel, the small quantities of sulphur present in water-gas soon brought the reaction to an end owing to "poisoning" of the nickel. Mr. Evans had shown that in spite of this, if the temperature of the gases was raised to about 450°, the nickel was capable of removing the sulphur without any "poisoning" being observable after two years. The great difficulty in the way of devising a suitable process for removing the carbon bisulphide had been that of cost. Many chemical methods were available for the purpose, but all had proved prohibitive in cost. A further interesting point

was that Mr. Evans had now satisfactorily proved that the conversion of carbon bisulphide into sulphuretted hydrogen was due to its interaction with hydrogen, and not with steam. Was the slight increase in methane due to its synthesis from the carbon monoxide and hydrogen, or was it possibly really ethane formed from the ethylene and hydrogen, in presence of the nickel? In what form was the sulphur left in the gas after treatment? Probably it was chiefly in the form of thiophen, in which case it would be very difficult to remove it without affecting the benzene, with consequent considerable reduction of the illuminating and calorific power of the gas. Possibly, however, some of the sulphur was in the form of methyl or ethyl sulphides.

Mr. W. E. Oakden asked what difference in the percentage of decomposition was made by the presence of the catalyst. Had the process been applied to coal gas or to producer gas? What was the extent of the decomposition of sulphuretted hydrogen into hydrogen and sulphur?

Dr. R. Lessing said that the time which was occupied in bringing the process to a successful issue, even if it were seven years, was quite a record time, because it involved a great number of initial failures in small experimental plants before a working plant could be evolved. He believed that in one works alone 15,000,000 cb. ft. of coal gas was treated every day, which could not be acted on detrimentally without affecting the regular gas supply to an enormous district. Had any relation been established between the amount of carbon produced and the amount of sulphur? Was it now possible to establish a balance, so that it was possible to say that the carbon deposited on the nickel, and afterwards burned off in the form of $CO_2$, tallied with the amount of sulphur recovered from the final gases? Possibly the determination of the $CO_2$ in the final gas, knowing the gas on the inlet side and the $CO_2$, would give an answer. With regard to the methane, if hydrogenating reactions occurred, the free carbon should be rather less than that given by the equation. If they did not, and if possibly some dehydrogenation took place, the carbon would be somewhat more than the sulphur equivalent required.

Mr. F. Napier Sutton said that those who had seen the process in practical use had been much struck with its wonderful practicability and beauty, both mechanically and chemically. He had not actually seen the latest improvements introduced at the East Greenwich plant, but a year or so ago he had examined the process in detail at the Old Kent Road works, and the difference in results obtained between this reaction for the removal of carbon bisulphide, as compared with the old lime process, was simply marvellous. He believed the amount of sulphur remaining in the gas was about 8 grains per 100 cb. ft., whereas he believed that in coal gas passed into the mains by most companies it was something like 30 or 40 grains. The gas thus became a sort of standard which in course of time probably every other company would adopt.

Mr. W. J. A. Butterfield said that the process was an admirable instance of the co-operation of the chemist and the engineer. Though except for the use of this particular catalyst, the chemical process was not novel, the earlier attempt on a large experimental scale 30 or more years ago had failed completely, because the engineers concerned in its development had lost heart when the first plant did not go quite properly. This process originated after the compulsion which formerly existed in regard to the removal of sulphur compounds had been removed by Parliament from the London Gas Companies. Dr. Carpenter and his co-directors had thought it desirable that the sulphur in the form of carbon bisulphide should be removed from the gas, and this was now done on their own initiative. Without any compulsion, they had set about producing gas by an entirely novel process of a higher degree of purity than had hitherto been provided. On that account he would be rather averse to attempting to exercise compulsion on other companies, who would, in their own interests, sooner or later adopt sulphur purification. The residual sulphur which was left in the gas after treatment by the new process, was evidently mostly thiophen. If that were the case, the process of washing with alcohol, which had been advocated for the removal of carbon bisulphide, should remove the thiophen also. That process had been tried in Sweden, and he believed it was being tried, or was about to be tried, in this country. When the results were published, it would be interesting to see whether the sulphur came down from the 7 or 8 grains per 100 cb. ft. to practically *nil*. In the "Athion" process, as used at Heidelberg recently, the large size of the vessels relatively to the work done, convinced him that for working on a really large scale the process was quite impracticable. The "Athion" and all other processes except Mr. Evans' and the alcohol washing process, required the previous removal of the carbon dioxide from the gas, and the expense of this removal put them out of court as competitors with the new process.

Mr. Evans, in reply, said that about 60% of the sulphur compounds remaining after the process consisted of thiophen, but the remainder had so far evaded detection or classification. During the carbonisation of coal one imagined that methyl and ethyl sulphides were produced, together with certain mercaptans, but the latter would become rapidly decomposed in a process of this nature. His company had attempted to apply a process for removing thiophen but not benzene, depending on the formation of double thiophen-mercury sulphate compounds. It was proposed to separate subsequently the benzene and thiophen and to return the former to the coal gas. It appeared that the process would be too costly for industrial use. The question as to the extent of the decomposition with and without the catalyst could be answered indirectly. The function of the catalyst was to reduce the temperature of the reaction. Contact material alone was capable of effecting exactly the same reduction of sulphur compounds, but at a temperature of about 60° to 100° C. higher, which became dangerous to the iron apparatus of the plant. The quantity of carbon oxysulphide produced would be practically unmeasurable if the amount of sulphuretted hydrogen in the gas were below 100 grains per 100 cb. ft. Dr. Lessing's question as to whether there was a relation existing between the amount of carbon dioxide and the amount of carbon bisulphide decomposed, could only be cleared up in the laboratory with the purest chemicals. They always knew after each aeration the weight of carbon that had been burned off in the plant. Calculating back to the amount of work done, it was found that the quantity of carbon was about double that represented by the carbon bisulphide decomposed, which indicated that certain unsaturated hydrocarbons in the gas had been decomposed. That decomposition, after the decomposition of carbon bisulphide, was purely a question of temperature, and it was therefore important to work at the lowest temperature compatible with high efficiency.

With regard to the average figures for the working of the plant, there was usually about 39 grains of sulphur compounds in gas made from Northumberland and Durham coal, and that was reduced to from 7 to 8 grains, representing a reduction of 80%.

## Obituary.

G. V. PEARCE.

Second Lieutenant Geoffrey Vincent Pearce, Royal Warwickshire Regiment, only son of Mr. William Pearce, M.P., of 14, Park Crescent, W., has died from wounds received in action on Dec. 18th, aged 25 years. Formerly a sergeant in the Uppingham School Corps, he afterwards joined the Artists' Rifles, with whom he went to the Front in October last. On arrival he was selected for a Commission in the Royal Warwickshire Regiment. He was elected a member of this Society in 1912, and was employed at the works of Messrs. Spencer, Chapman and Messel at Silvertown. He was a most promising young chemist.

# Journal and Patent Literature.

PATENT SPECIFICATIONS may be obtained by post by remitting as follows:—
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## I.—GENERAL PLANT; MACHINERY.

### PATENTS.

*Separation and grading of various materials; Centrifugal ——.* E. Holwill, London. Eng. Pat. 26,127, Nov. 14, 1913.

A CENTRIFUGAL drum is constructed with an outer impervious and an inner concentric porous cylindrical wall leaving a closed annular space between. The mixture of solids and liquid is passed downwards through the rotating drum and the solids are deposited on the inner surface of the porous cylinder, graded according to size, the bulk of the liquid passing away from the lower end of the drum. When a sufficient quantity of solid material has collected, the supply is stopped and the liquid which has collected in the annular space is drawn off. On the rotation being continued the liquid still retained by the deposited solids is forced through the porous wall.—W. H. C.

*Centrifugal machines.* A. R. Robertson, Glasgow. Eng. Pat. 8306, April 2, 1914.

THE dried material is discharged from the basket of a centrifugal machine by a scoop device which projects from a hub surrounding the central shaft. When the machine is ready to be discharged, a brake is applied to the hub before the rotation of the drum is stopped so that the scoops move relatively to the drum and detach the lower portions of the deposit, whereupon the remainder easily falls away.—W. H. C.

*Centrifugal apparatus.* W. Mauss, Johannesburg, S. Africa. Eng. Pat. 15,930, July 3, 1914.

THE drums of a planetary centrifugal machine are rotated individually by means of two concentric, internally-toothed wheels which engage with a pair of planet wheels.—W. H. C.

*Separators; Centrifugal —— of the planetary type.* W. Mauss, Johannesburg, S. Africa. Eng. Pat. 17,724, July 27, 1914.

THE separator is of the type in which the vertical drums are placed close to the main axis and from which the deposited material is removed by ploughs or scrapers (see Eng. Pat. 6478 of 1913; this J., 1913, 858). The drums are made with a cylindrical central portion and an upper and lower conical portion.—W. H. C.

*Separator; Centrifugal —— driven by a low-pressure turbine.* Aktiebolaget Baltic. First Addition, dated Feb. 16, 1914 (Under Int. Conv., Feb. 18, 1913), to Fr. Pat. 449,542, Oct. 17, 1912 (this J., 1913, 503).

A RECIPROCATING engine is substituted for the low-pressure turbine and a high-pressure for a low-pressure steam generator in the separator described in the original patent.—W. H. C.

*Furnaces and kilns; Pulverulent and liquid fuel — —.* S. M. Seddon, Salt Lake City, Utah, U.S.A. Eng. Pat. 27,373, Nov. 27, 1913. Under Int. Conv., Jan. 28, 1913.

THE conduit through which warm air flows to the blower is enclosed in a mixing chamber, and the fuel is led over the upper surface of the conduit and enters the latter on the under side. The proportions of the mixture are adjusted by valves or dampers, and means are provided for removing any heavy particles that may accidentally accompany the fuel.—W. H. C.

*Regenerator-furnace.* W. E. Moore, Peru, Ill., H. L. Moore, Executrix. U.S. Pat. 1,117,219, Nov. 17, 1914. Date of appl., Jan. 26, 1914.

TWO furnaces placed side by side are separated by a single partition wall, and a series of longitudinal regenerator chambers below the furnaces are connected with them by flues and provided with reversing dampers to change the direction of flow of the gas and air.—W. H. C.

*Retort.* R. G. Stiles, Parkersburg, W. Va. U.S. Pat. 1,117,923, Nov. 17, 1914. Date of appl., Nov. 4, 1913.

A RETORT of square section has a square doorway at one end. The bottom of the doorway is slightly above the bottom of the retort to provide a steam and water chamber, over which a series of grids are placed level with the sill of the doorway. The door is held in position by a swinging dog-screw and a valved steam outlet is provided for the vapours.—W. H. C.

*Temperatures; Apparatus for indicating and regulating* ——. I. Hall, Birmingham. Eng. Pat. 28,346, Dec. 9, 1913.

IN the apparatus described in Eng. Pat. 21,072 of 1912, a single pivoted rod or lever is used, one end of which rests upon part of, and is actuated by a differential expansion device comprising a carbon or other non-metallic rod and a metal tube, and and the other controls the valve through which the gas enters the burner.—W. H. C.

*Drying apparatus; Rotary chamber* ——. G. Binder, Rochester, N.Y., U.S.A. Eng. Pat. 8936, April 8, 1914. Under Int. Conv., Jan. 21, 1914.

AIR is circulated by means of a fan continuously through a screening chamber, a heating chamber, and a rotary drying chamber. After passing the screening chamber, a portion of the air, containing the greater part of the moisture, is discharged into the atmosphere, and the remainder, together with some fresh air, is re-circulated through the train of apparatus.—W. H. C.

*Desiccating organic matter.* W. H. Allen, Cleveland, Ohio. U.S. Pat. 1,118,884. Nov. 24, 1914. Date of appl., Nov. 4, 1912.

THE substance is enveloped in a magnetic field and a current of dry air, heated above 110 F. (43° C.) by the magnetising current, is circulated over it.—J. H. J.

*Drying granular materials; Process and apparatus for* ——. J. A. Topf and Söhne. First Addition, dated Feb. 11, 1914, to Fr. Pat. 461,679, Aug. 21, 1913.

THE drying apparatus is divided into compartments by vertical and inclined partitions, so that the path of the material under treatment is diverted in one direction only from the vertical. The dried material is discharged from the bottom of the apparatus through two doors which are opened alternately by mechanical means.—W. H. C.

*Gases; Treatment of* ——. E. B. Wolcott, Chicago, Ill. U.S. Pat. 1,116,661, Nov. 10, 1914. Date of appl., Aug. 14, 1909.

THE gases are passed spirally downwards over the interior surface of a cylinder and then upwards through the central portion of the cylinder, in which is a series of electrodes or other heating means to induce chemical combination of the gases. The gases are subsequently cooled.—W. H. C.

*Evaporator.* F. M. de Beers, Chicago, Ill. U.S. Pat. 1,117,005, Nov. 10, 1914. Date of appl., July 19, 1913.

THE evaporator is constructed of antimonial lead, strengthened by iron angles or tees imbedded in the lead.—W. H. C.

*Filtering medium* [*tile*]. J. E. Porter, Syracuse, N.Y., Assignor to General Filtration Co., Inc., Rochester, N.Y. U.S. Pat. 1,117,601, Nov. 17, 1914. Date of appl., May 9, 1913.

A RAPID filtering tile is made by fusing a mixture of 75 to 85% of a silicious substance with 25 to 15% of powdered glass.—W. H. C.

*Treating a current of liquid with a gas; Apparatus for* ——. G. Ornstein. Fr. Pat. 469,275, March 7, 1914. Under Int. Conv., May 9, 1913.

THE liquid is passed through a Venturi tube, and the variation in pressure before and after the constriction, due to the variation in the quantity of liquid flowing through the tube, is utilised to control the supply of compressed gas to the liquid. —W. H. C.

*Cooling compartments for rectifying columns.* E. Barbet et Fils et Cie. Fr. Pat. 469,979, June 4, 1913.

THE condensed liquid which collects on the bottom of each compartment or tray, is maintained at a temperature just below that of the ascending vapour by means of cooling coils. The hoods or covers of the bubbling devices are adjustably fixed to the vertical vapour pipes.—W. H. C.

*Cooling tower* [*for water*] *with aeration channels.* W. Vedder. Fr. Pat. 470,191, March 28, 1914. Under Int. Conv., March 29, 1913.

COOLING chambers, grouped around a central chimney, are provided with superposed horizontal channels through which the cooling air passes to the chimney. The liquid to be cooled falls in a finely divided condition across the horizontal currents of air. Radiation from the chimney is prevented in order to obtain a good up-draught. —W. H. C.

*Latent heat of evaporation of liquids; Apparatus for regenerating the* ——. E. Nobel and S. Bessonoff, St. Petersburg. U.S. Pat. 1,118,041, Nov. 24, 1914. Date of appl., Dec. 17, 1908.

SEE Fr. Pat. 395,108 of 1908; this J., 1909, 357. —T. F. B.

*Gas-light seals or closures between metal and vitreous material; Production of* ——. H. J. S. Sand, Nottingham, and F. Reynolds, London. U.S. Pat. 1,118,812, Nov. 24, 1914. Date of appl., Jan. 30, 1914.

SEE Eng. Pat. 23,854 of 1913; this J., 1914, 571. —T. F. B.

*Grinding-mills.* Bradley Pulverizer Co. Fr. Pat. 469,646, March 14, 1914.

SEE Eng. Pat. 6193 of 1914; this J., 1914, 950. —T. F. B.

*Separating solid bodies suspended in liquids; Process for* ——. B. Hofer. Fr. Pat. 469,727, March 17, 1914. Under Int. Conv., March 17, 1913.

SEE Eng. Pat. 6793 of 1914; this J., 1914, 939. —T. F. B.

*Centrifugal machines.* H. Broadbent. Fr. Pat. 469,950, March 21, 1914. Under Int. Conv., April 9, 1913.

SEE Eng. Pat. 8376 of 1913; this J., 1914, 582. —T. F. B.

*Centrifugal separators.* U.S. Pats. 1,119,173, 1,119,175 and 1,119,176. *See* XVII.

*Absorption pyrometer.* Eng. Pat. 27,633. *See* XXIII.

*Optical pyrometer.* U.S. Pat. 1,119,571. *See* XXIII.

## IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

*Coals available for export trade; United States* ——. V. H. Manning. U.S. Bureau of Mines, Tech. Paper 76, 1914. 15 pp.

ANALYSES, showing volatile matter, fixed carbon, ash, and sulphur, and a description of their physical properties and of the uses to which they

are adapted, are given for the coals from coalfields in the United States from which there are facilities for export.—O. E. M.

*Coal; Oxidation of* ——. H. C. Porter and O. C. Ralston. U.S. Bureau of Mines, Techn. Paper No. 65, 1914. 30 pp.

EXPERIMENTS were made to show the effect on the oxidation of coal of variation of temperature and of oxygen pressure, reduction of proportion of oxygen below that in ordinary air, and addition of carbon dioxide to the atmosphere. In general, below 200° C., oxygen is absorbed to form solid products and water. Above 200° C. there is little fixation of oxygen, and carbon dioxide is produced, the proportion being larger in an easily ignited coal. Carbon monoxide is also produced by the decomposition of the solid oxygen-derivative.—W. F. F.

*Coal in boiler furnaces; Factors governing the combustion of* ——. J. K. Clement, J. C. W. Frazer, and C. E. Augustine. U.S. Bureau of Mines, Tech. Paper 63, 1914. 46 pp.

EXPERIMENTS with a furnace having an unusually long combustion chamber, from which samples of the gases could be drawn at intervals along its length, showed that, with a constant rate of firing, the time necessary for complete combustion of the gases, and hence the length of chamber required, decrease with increasing air supply.—O. E. M.

*Mixed coal- and water-gas; Separation of the illuminants in* ——. G. A. Burrell and I. W. Robertson. Amer. Gas Inst. J. Gas Lighting, 1914, **128**, 615—616.

THE illuminants in the Pittsburgh gas, made by mixing one part of carburetted water-gas with three parts of coal gas, were separated by fractional distillation (see this J., 1914, 808). The gas was freed from carbon dioxide by caustic potash and then cooled by liquid air and subjected to a series of fractionations which gave a residue of the illuminants. A second series of fractionations removed the ethane and ethylene, a third series removed propane and propylene, and a fourth series removed butylene and butane. Benzene was determined by fractionation of a separate quantity of the gas. The composition of two samples of the gas taken on different dates was: $CO_2$ 2·40, 2·43; $O_2$ 0·80, 0·61; CO 13·25, 13·63; $H_2$ 37·33, 37·13; $CH_4$ 31·13, 30·92; $C_2H_6$ 2·10, 1·92; $C_3H_8$ 0·35, 0·32; $C_2H_4$ 6·05, 6·36; $C_3H_6$ 0·60, 0·70; $C_4H_8$ 0·11, 0·12; $C_6H_6$ (1 sample), 1·33; $N_2$ (1 sample) 4·32 %. The calorific value of the illuminants alone was calculated to be 2162 B.Th.U.—W. F. F.

*Hydrogen in gas mixtures; Determination of —— by means of colloidal palladium.* G. A. Burrell and G. G. Oberfell. J. Ind. Eng. Chem., 1914, **6**, 992—994.

THE use of a solution of sodium picrate and colloidal palladium for determining hydrogen in gas mixtures is described (see Paal and Hartmann, this J., 1910, 236; Brunck, this J., 1911, 110). Hempel (this J., 1912, 911) has stated that the solution slowly loses its absorbing power even in the dark, but the authors have obtained satisfactory results with a solution which had been kept for 9 months in a pipette surrounded with black paper.—A. S.

*Gasoline vapour in natural gas; Absorption of —— by fuming sulphuric acid.* R. P. Anderson and C. J. Engelder. J. Ind. Eng. Chem., 1914, **6**, 989—992.

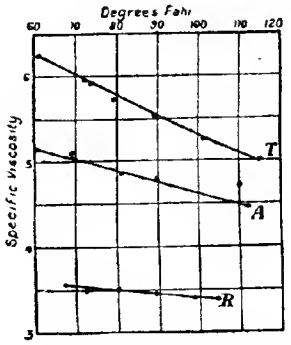
GASOLINE vapours are absorbed to a considerable extent by fuming sulphuric acid, the amount of absorption increasing with the molecular weight of the hydrocarbons. The suitability of a natural gas for the manufacture of gasoline may be ascertained by determining the absorption under definite conditions, but it is desirable in such cases to determine also the composition of the gas before and after treatment with the acid. Samples of natural gas from which respectively 1 gallon of gasoline of 90° B. (sp. gr. 0·643) and 5 gallons of 97° B. (sp. gr. 0·624) per 1000 cb. ft. were recovered on a commercial scale, showed a decrease of volume of 9·8 and 30% when passed 30 times over fuming sulphuric acid (30 % $SO_3$) in a modified Orsat apparatus (Dennis, "Gas Analysis," p. 86). —A. S.

*Ammonium chloride as a by-product of coke ovens, gas works, etc.* W. Strommenger. Z. angew. Chem., 1914, **27**, 518—520.

THE working up of the ammoniacal liquors into pure ammonium chloride, instead of crude ammonium sulphate, is especially desirable in view of the introduction of synthetic nitrogen compounds on to the market as manures in competition with the older sources of supply. For this purpose, the liquors, which already contain some ammonium chloride, are treated with a slight excess of hydrochloric acid, and the decomposition of the other ammonium salts and the oxidation of the iron present, are facilitated by a current of air. The sulphur precipitated during this process is almost pure and forms a valuable by-product. A slight excess of ammonia is added to the filtered liquors to precipitate iron and other impurities. The filtrate is neutralised with hydrochloric acid, treated with sufficient common salt to convert all the undecomposed sulphate into chloride, evaporated to dryness, and ammonium chloride separated by sublimation, leaving a residue of sodium sulphate mixed with small quantities of sodium chloride and carbon (from the organic impurities). Recrystallisation of the sublimate is for most purposes unnecessary, but the innermost layers are liable to contain traces of volatile organic matter, which, though not recognisable by analysis, cause the crystals to darken on exposure to air and light. A single crystallisation completely removes them.—G. F. M.

*Gas-oils; Determination of the viscosity of* ——. A. V. Hendrickson. J. Gas Lighting, 1914, **128**, 600—601.

THE determination of the viscosity of oils used in the manufacture of carburetted water-gas is suggested as a means for determining the origin




of the oil. An Ostwald viscosimeter is used, immersed in a water-bath at constant temperature. The specific viscosities (viscosity of water = 1)

of Texas, American, and Roumanian oils at various temperatures are represented in the graph by T, A, and R, respectively.—W. F. F.

*Crude petroleum, oil-fuel, and similar substances; Rapid methods of determining water in ——.* H. S. Shrewsbury. Analyst, 1914, **39**, 529—531.

*Distillation method.*—100 c.c. of the oil and a few pieces of pumice stone are placed in a 500 c.c. distillation flask supported with its side tube perpendicular to the bench. The tube is inserted up to the neck of the flask in a 25 c.c. graduated cylinder, which is surrounded by cold water. After the neck and surface of the flask (uncovered by the oil) have been heated by a flame to prevent the condensation of water, the oil itself is heated until the water has been driven over into the cylinder, the process being completed by distilling a few c.c. of the oil. The cylinder is then rotated rapidly, to cause the water to settle, and the volume of the water is read; dry petroleum spirit may be added to the distillate to accelerate the separation. *Turbidity temperature process.*—This method depends on the possibility of extracting water from oil-fuel with glacial acetic acid, and the delicacy with which the turbidity temperature of glacial acetic acid and a standard oil responds to the presence of minute quantities of water. A suitable standard oil (giving a turbidity temperature of 49° C. with glacial acetic acid) may be prepared by mixing equal volumes of arachis and coconut oils; a correction is necessary for the effect on the turbidity temperature of substances other than water extracted from the oil-fuel, and this is found by a blank determination on oil which has been dried by boiling for a short time in an open dish. New standards must be prepared for every fresh stock of acetic acid. Ten c.c. of standardised glacial acetic acid is placed in a dry, stoppered, graduated 25 c.c. cylinder and 10 c.c. of the oil-fuel is added. The cylinder is shaken, its contents are transferred to a separator, the acid extract is drawn off, passed through a dry filter, and 2 c.c. of the filtrate is heated in a test-tube with 2 c.c. of the standard oil until the mixture is clear, the turbidity temperature being then determined in the usual way. When the oil contains more than 2·5% of water, the acetic acid extract must be diluted with the standard acid, exactly the same dilution being made with the extract which gives the figure for the blank. The results obtained by the two methods are fairly concordant. Both methods would probably be applicable to the determination of water in butter, margarine, lard, and other oils and fats.—W. P. S.

*Alcohol as a substitute for benzine for driving motor cars.* W. Hempel. Z. angew. Chem., 1914, **27**, 521—522.

In 1912 Germany produced 179,800 tons (metric) of benzine; in 1913, 160,000 tons of benzol (of which 50,000 tons were exported to France; and in 1912—1913, 3,753,265 hl. of alcohol. All motor cars in Berlin have been adapted to use alcohol as well as benzine. The following are the respective heats of combustion of the different substances tried in the experiments:—Benzine, 9500—10,500; pure benzene, 10,260; commercial 90% benzol 9550—10,000; pure alcohol, 7402; 95% alcohol, 5875; and pure naphthalene, 9028·3 Cals. per kilo. Alcohol denatured with 2 to 20% of benzene is much more suitable for motor engines than that containing wood alcohol or pyridine. According to Dieterich a mixture of 1 vol. of petroleum spirit with 2 vols. of benzene is particularly suitable for the purpose. After suitable regulation of the tubes of a Lyma carburetter the following mixtures could be used:—(1) A mixture of 4 vols. of 95% alcohol and 1 vol. of 90% benzol containing 200 grms. of naphthalene per litre. (2) Four vols. of 95% alcohol and 1 vol. of crude benzol containing 200 grms. of naphthalene per litre. (3) Four vols. of 95% alcohol and 1 vol. of light coal-tar oil containing 200 grms. of naphthalene per litre. In a long run 18 litres of mixture I gave the same result as 15 litres of ordinary petrol. Only oils purified by sulphuric acid and alkali should be used for this purpose. There is also a possibility of using a solution of acetylene in acetone (which dissolves 31 vols.) or alcohol (6 vols.). The use of pure alcohol tends to produce rust in the engine.—C. A. M.

*Substitutes for benzine and benzol in motor engines.* K. Dieterich. Z. angew. Chem., 1914, **27**, 543—544.

The following mixtures are recommended as suitable substitutes for petrol:—I. (*a*) Alcohol (95%), 70; benzol 30 parts. (*b*) Alcohol (90%), 50; commercial acetone, 20; benzol, 30 parts. II. (*a*) Alcohol (95%), 70; benzine 30 parts. (*b*) Alcohol (90%) 50; commercial acetone, 20; benzine, 30 parts. III. (*a*) Alcohol (95%) 90; ether, 10 parts. (*b*) Alcohol (95%), 90; ether 10; naphthalene, 1 part. IV. (*a*) Alcohol (95%), 70; commercial acetone, 30 parts. (*b*) Alcohol (90%), 50; commercial acetone, 50 parts. V. (*a*) Petroleum, 2; benzine, 1 part. (*b*) Petroleum, 3; acetone, 1 part. (*c*) Petroleum, 90; ether, 10 parts containing 1 part of naphthalene. All these substitutes require preliminary heating of the carburetter and reduction of the supply of air. To prevent rust one litre of motor oil should be dissolved in 100 litres of the mixture.—C. A. M.

*Alcohol as a motor-spirit.* O. Mohr. Z. angew. Chem., 1914, **27**, 558—559.

Only the simplest mixtures of alcohol with hydrocarbons have proved suitable as substitutes for petrol in motor engines. Mixtures of equal parts of alcohol and benzene or of alcohol (50), benzene (25), and petrol (25), have given good results, the second mixture having the advantage of not forming crystalline deposits in winter. Naphthalene proved unsuitable owing to the formation of deposits. The use of alcohol containing 0·5% ammonium perchlorate is objectionable owing to the gaseous chlorine compounds formed in the explosion. —C. A. M.

*Determination of Prussian blue in cyanide mud.* Anderson. *See* VII.

*Rock asphalts of Oklahoma and their use in paving.* Snider. *See* IX.

*Cementing value of bituminous binders.* Kirschbraun. *See* IX.

*Iodine value of linseed and petroleum oils.* Smith and Tuttle. *See* XII.

## Patents.

*Briquettes; Process for making —— without coal.* E. L. Geelhand and J. de Man-Roeis. Fr. Pat. 469,293, Feb. 9, 1914.

Briquettes are formed of gum copal, wood chips, bark or the like, and loam.—W. F. B.

*Briquettes; Process for making ——.* A. Epp. Fr. Pat. 470,136, Mar. 26, 1914.

Clay and sawdust are heated in a mixer preferably by high-pressure steam, coal tar and previously boiled pine resin are added, and nitric and sulphuric acids are then agitated with the mixture, which is cooled, moulded, and exposed to the

atmosphere for one or two days. An alternative process consists in using clinker or ashes with finely-divided pitch, tar, and sulphuric acid.—W. F. B.

*Gas [firedamp] admixed with air or other gases; Apparatus for indicating the presence and estimating the proportion of a* ——. H. R. Webster, Horsforth. Eng. Pat. 26,001, Nov. 13, 1913.

A THIN metallic diaphragm closing a porous vessel is distended when diffusion of a gas into the vessel takes place, and makes electrical contact with a rod. To make the apparatus quantitative the original distance of the rod from the diaphragm is adjustable by a micrometer screw. The closing of the circuit is indicated by a bell or lamp.—O. E. M.

*Gas-retorts; Vertical* ——. R. Dempster and Sons, Ltd., Elland, and F. G. Brockway, Cleethorpes. Eng. Pat. 1997, Jan. 26, 1914.

A TABLE for supporting the charge stands during carbonisation on the bottom lid of the retort, falls out of the way when the lid is opened for discharging, and is replaced by means of a chain let down through the retort.—O. E. M.

*Water-gas; Production of* ——. R. P. Pictet, Berlin. Eng. Pat. 24,374, Oct. 27, 1913.

PURE or nearly pure oxygen is passed, with steam, continuously through fuel at 1500°—1800° C.
—O. E. M.

*Water-gas; Conversion of carbon monoxide in —— into methane.* L. Vignon. Fr. Pat. 469,907, June 2, 1913.

WATER-GAS is mixed with a determined quantity of steam and passed over quicklime heated to 350°—1200° C. Below about 850° C. calcium carbonate, methane, and hydrogen are produced, whilst above this temperature the calcium carbonate is decomposed, and the resulting gas also contains carbon dioxide. Small quantities of other hydrocarbons, such as ethylene, are also formed. (See also Fr. Pat. 416,699; this J., 1910, 1366.)—W. F. B.

*Producer-gas generators.* T. R. Wollaston, Manchester. Eng. Pat. 29,088, Dec. 17, 1913.

A PRODUCER, of any suitable type, is provided with a number of hermetically sealed tubes (Perkins tubes) containing a small quantity of fluid, which abstract heat from the burning fuel and transmit it to a boiler, fixed on the top of the producer. The steam from the boiler passes by a pipe, fitted with an air injector, to the jacket of the producer, and thence into the fuel bed.—W. F. F.

*Gas; Manufacture of carburetted* ——. W. J. Watkins, Assignor to O. G. Hurdleston, Fort Worth, Tex. U.S. Pat. 1,116,653, Nov. 10, 1914. Date of appl., May 15, 1911.

THE lower half of the generating chamber is provided with a number of horizontal fibre partitions, connected by a central fibre stem. A volatile combustible liquid from a container in the upper part of the generator is distributed over layers of a mixture of pine shavings and iron borings placed on the partitions, and compressed air from a reservoir is blown downwards through the layers, the carburetted gas being drawn off from a chamber at the base of the generator.—W. F. F.

*Combustion products; Generation of —— under pressure for actuating turbines.* The Warwick Machinery Co. (1908), Ltd., London. From General Electric Co., New York. Eng. Pat. 482, Jan. 7, 1914.

COAL dust is stored in a closed hopper under air pressure from a branch pipe of the main air supply. A rotary valve in the base of the hopper, driven at a controllable speed, admits the coal dust into the main air pipe, from which it is blown tangentially into the conical top of the combustion chamber. The ignited mixture thus has a downward spiral movement, the ash being thrown against the sides and falling into a series of pockets formed in the bottom of the combustion chamber. The gaseous combustion products escape by a water-jacketed pipe extending from the top of the combustion chamber nearly to the base.—W. F. F.

*Gases and gaseous atmospheres of non-oxidizing character; Manufacture of* ——. H. Frasch, New York (E. B. Frasch, New York, and F. F. Whiton, Hewlett, N.Y., executrices). U.S. Pat. 1,118,899, Nov. 24, 1914. Date of appl., Sept. 28, 1914.

AIR, mixed with a small proportion of hydrocarbon vapour, is passed over incandescent carbon, the resulting gaseous mixture consisting of nitrogen, carbon monoxide and dioxide, and hydrogen.
—W. F. F.

*Gas-washer.* H. Bentz, Montclair, N.J. U.S. Pat. 1,117,309, Nov. 17, 1914. Date of appl., June 5, 1914.

THE gas passes through a casing, where it meets a body of mist which coats the suspended solid particles. It then passes successively, at increased velocity, between two series of plates supplied with a flowing film of water, whereby suspended particles are removed and the gas is cooled, and then between a final series of plates, without a water film, to eliminate entrained moisture.
—W. F. F.

*Hydrocarbons of low boiling-point; Production of —— from those of higher boiling-point.* W. A. Hall, New York. Eng. Pat. 18,342, Aug. 12, 1913.

HYDROCARBON oil is agitated with 50% of lime-water; a small quantity of ferrous or aluminium sulphate is added, and the precipitate formed is removed by filtration. The filtrate contains the oils of lower boiling point.—O. E. M.

*Mineral oils of low boiling-point; Production of —— from those of high boiling point.* Continental Caoutchouc und Gutta Percha Co. Fr. Pat 469,948, March 21, 1914. Under Int. Conv., March 22 and Oct. 4, 1913.

THE fraction of high boiling-point is heated with a catalyst such as aluminium chloride, with or without mercuric, ferric, vanadium, or other chloride, or with aluminium in a stream of dry hydrochloric acid gas, or is atomised or exposed to ultra-violet rays or the silent electric discharge in presence of a catalyst. The process is continuous. Gaseous products are obtained by heating to a higher temperature, and longer, in closed vessels.—O. E. M.

*Liquid hydrocarbons [pentanes]; Process of obtaining —— [from natural gas].* E. Schill, Assignor to Continental Gas Compressing Corporation, New York. Reissue No. 13,829. Nov. 17, 1914, of U.S. Pat. 1,100,260, June 16, 1914. Date of appl., June 19, 1914.

NATURAL gas is highly compressed in the presence of a finely-divided inert heat-absorbing agent which is also a water absorbent, a lubricant and a conductor of heat, and has a high specific heat, specific gravity, and boiling point. The temperature is reduced to 25° C., and the liquefied portion, which contains the pentanes and other hydrocarbons of higher boiling point, is removed while still under pressure, and the pentanes separated by fractional

distillation. The method may be extended to the separation of hydrocarbons of low, medium, and high boiling points from a gaseous mixture of these substances, by condensing the portions having medium and high boiling points after the initial compression, removing the gaseous portion, and fractionating the liquid portion.—W. F. F.

[*Paraffin*] *wax; Producing —— from other hydrocarbons.* W. M. Burton. Chicago, Ill., Assignor to Standard Oil Co., Whiting, Ind. U.S. Pat. 1,112,113, Sept. 29, 1914. Date of appl., Jan. 21, 1914.

Fuel oil, produced in the distillation of petroleum, and free from wax, is distilled at 650°—850° F. (343°—454° C.) under a pressure of 4 to 5 atmospheres. The residuum, about one-third of the original charge, is completely distilled at atmospheric pressure, the distillate cooled, and the paraffin wax, which amounts to about 2%, removed in a press. The expressed oil may be again treated as described, or may be mixed with a fresh charge of fuel oil.—W. F. F.

*Oil-refiner.* F. R. Reynolds, Bakersfield, Cal. U.S. Pat. 1,119,453, Dec. 1, 1914. Date of appl., Aug. 9, 1913.

Flat jacketed steam drums, arranged one above the other, are connected by short vertical pipes, and the jackets are also connected together. Crude oil is passed through the jackets, entering at the uppermost. A tank with openings at top and bottom encloses the whole. On leaving the lowest jacket, the oil passes over inclined baffle-plates and is finally led away by the outlet at the bottom of the tank, the gases escaping through the outlet at the top.—W. F. F.

*Petroleum; Method of distilling ——.* E. M. Clark, Alton, Ill. U.S. Pat. 1,119,496, Dec. 1, 1914. Date of appl., April 20, 1914.

The liquid residue from petroleum distillation is circulated rapidly in a small stream while subjected to a cracking temperature. The vapour is condensed at 650°—850° F. (343°—454° C.), under a pressure of 3—7 atmospheres.—W. F. F.

*Hydrocarbons* [*petroleum residues*]; *Method of distilling ——.* R. E. Humphreys, Whiting, Ind., Assignor to Standard Oil Co., Chicago, Ill. U.S. Pat. 1,119,700, Dec. 1, 1914. Date of appl., June 26, 1914.

Petroleum residues boiling above 500° F. (260° C.) are distilled at a pressure above 4 atmospheres, the distillate being returned to the still for further treatment. The lighter vapours, which consist of hydrocarbons of the same series but having lower boiling points, are condensed while still under pressure.—W. F. F.

*Organic esters of the fatty series; New application of —— [as motor spirit].* Soc. d'Etude du Carburx. First Addition, dated Feb. 25, 1914, to Fr. Pat. 461,520, Aug. 20, 1913 (this J., 1914, 191).

The esters mentioned in the original patent may be used, mixed with aromatic or fatty hydrocarbons, in internal combustion motors.—O. E. M.

*Liquid hydrocarbons* [*petroleum*]; *Electrically-heated still for ——.* T. Delort. First and Second Additions, dated March 6 and April 20, 1913, to Fr. Pat. 469,054, Feb. 8, 1913 (this J., 1914, 954).

The liquid in an upper compartment of the still is heated by, and condenses, the vapour from a lower compartment; its more volatile portions pass off to a condenser cooled by fresh, untreated liquid, while the less volatile portions pass into the lower compartment over inclined planes, the temperature of which increases from the top towards the bottom.—O. E. M.

*Benzine; Regeneration of impure ——.* M. Granger. Fr. Pat. 469,490, March 11, 1914.

*Benzene from petroleum or its distillates; Process for obtaining ——.* J. Holcgreber. First Addition, dated March 7, 1914, to Fr. Pat. 460,827, July 28, 1913 (see this J., 1914, 17).

Increased yields of benzene may be obtained from petroleum or its distillates by treatment with hydrogen in presence of a mixture of metallic oxides, instead of the metals themselves. The oxides are either used in the form of powder or deposited on pumice stone, to present a large surface. Mixtures of the oxides of nickel and copper, or cobalt and iron may be used with advantage.—T. F. B.

*Fires in oil tanks, garages, and the like; Extinguishing ——.* J. B. and O. R. Erwin, Milwaukee, Wis., U.S.A. Eng. Pat. 2142, Jan. 27, 1914.

A small vessel containing sulphuric acid is suspended by a catch which is released by the falling of a weight when a fusible link is destroyed. The acid vessel, open at the top, then sinks slowly through a mixture of sodium bicarbonate and soap bark solution contained in a deep vessel within or adjacent to the oil tank, or below the floor of the garage or other building. Violent ebullition is produced and the foam overflows on the surface of the burning oil and extinguishes the fire.—W. F. F.

*Dust; Composition for agglutinating ——.* H. Belger, Cullercoates. U.S. Pat. 1,120,362, Dec. 8, 1914. Date of appl., Sept. 10, 1913.

See Eng. Pat. 6343 of 1913; this J., 1913, 690. —T. F. B.

*Peat; Process for dehydrating ——.* Wetcarbonizing, Ltd. Fr. Pat. 469,447, March 9, 1914. Under Int. Conv., March 10, 1913.

See Eng. Pat. 5873 of 1913; this J., 1914, 783. —T. F. B.

*Peat-dewatering process.* T. Rigby and G. W. Andrew, Dumfries, Assignors to Wetcarbonizing, Ltd., London. U.S. Pat. 1,121,203, Dec. 15, 1914. Date of appl., March 0, 1914.

See Eng. Pat. 5873 of 1913; this J., 1914, 783. —T. F. B.

*Peat-dewatering process.* T. Rigby, Dumfries. Assignor to Wetcarbonizing, Ltd., London. U.S. Pat. 1,121,204, Dec. 15, 1914. Date of appl., March 6, 1914.

See Eng. Pat. 11,133 of 1913; this J., 1914, 912. —T. F. B.

*Gaseous fuel; Apparatus for the production of ——.* A. W. Southey, Edgware. U.S. Pat. 1,120,857. Dec. 16, 1914. Date of appl., Dec. 6, 1913.

See Eng. Pat. 27,612 of 1911; this J., 1913, 77. —T. F. B.

[*Gas*] *retort-discharging apparatus.* A. Dobson, Halifax, Assignor to Drakes, Ltd., Ovenden. U.S. Pat. 1,121,551, Dec. 15, 1914. Date of appl., Feb. 17, 1914.

See Eng. Pat. 4105 of 1913; this J., 1914, 684. —T. F. B.

*Separating gaseous mixtures into their constituents; Process of* ——. R. P. Pictet, Berlin-Wilmersdorf, Germany. U.S. Pat. 1,119,312, Dec. 1, 1914. Date of appl., June 27, 1913.

See Fr. Pat. 457,031 of 1912; this J., 1913, 1109. —T. F. B.

*Suction gas-producer apparatus.* P. T. Houston, London. U.S. Pat. 1,119,603, Dec. 1, 1914. Date of appl., July 2, 1914.

See Eng. Pat. 15,367 of 1913; this J., 1914, 542. —T. F. B.

*Petroleum; Process for treating residues from the distillation of* ——. Standard Oil Co. Fr. Pat. 469,689, March 16, 1914.

See U.S. Pat. 1,105,961 of 1914; this J., 1914, 911. —T. F. B.

*Distilling petroleum or similar oils; Processes of —— and apparatus for carrying on these processes.* M. J. Trumble, Los Angeles, Cal., U.S.A. Eng. Pat. 22,497, Oct. 6, 1913. Under Int. Conv., Jan. 14, 1913.

See U.S. Pat. 1,070,361 of 1913; this J., 1913, 902. —T. F. B.

*Extinguishing fires; Method of* ——. R. Scheuffgen, Assignor to Fabrik Explosionssicherer Gefässe G.m.b.H., Salzkotten, Germany. U.S. Pat. 1,118,952, Dec. 1, 1914. Date of appl., March 21, 1912.

See Eng. Pat. 6327 of 1912; this J., 1912, 673. —T. F. B.

*Apparatus for automatic gas analysis.* U.S. Pat. 1,111,815. *See* XXIII.

## IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

### Patents.

*Peat; Process for dehydrating* ——. Wetcarbonizing Ltd. Fr. Pat. 469,448, March 9, 1914. Under Int. Conv., March 10, 1913.

In the dehydration of peat by wet carbonizing followed by treatment in a filter-press, a part or all of the hot liquid from the press is returned to the fresh pulp about to be treated, thereby saving heat and increasing the nitrogen content of the finished product.—W. F. B.

*Heating water and other liquids; Apparatus for* ——. A. C. Ionides. Eng. Pat. 26,259, Nov. 15, 1913.

The heater described in Eng. Pat. 15,455 of 1909, in which a combustible gaseous mixture is burnt without addition of further air, and from which the products of combustion are removed by downward displacement, has its heating chamber surrounded by a jacket in two parts, of which the upper can be swung aside for access to the chamber.—O. E. M.

*Filaments for incandescence electric lamps.* E. Morsaint. Fr. Pat. 469,902, June 2, 1913.

The filament consists of an intimate mixture of a conductor, such as tungsten, and a refractory non-conductor, such as boron carbide; it is thicker and more resistant to mechanical shock and over-running than a metallic filament.—O.E.M.

*Electrodes [for arc lamps].* J. T. H. Dempster, Schenectady, Assignor to General Electric Co., New York. U.S. Pats. 1,118,399 and 1,118,400, Nov. 24, 1914. Dates of appl., May 20, 1904, and Oct. 27, 1911.

See Eng. Pat. 14,196 of 1904; this J., 1905, 611. —T. F. B.

*Method of manufacture of metallic [tungsten] wires and strips.* Fr. Pat. 469,212. *See* X.

*Preparation of acetaldehyde from distillation gases.* Ger. Pat. 276,764. *See* XX.

## III.—TAR AND TAR PRODUCTS.

*Toluene in benzol; Test for* ——. J. Gas Lighting, 1914, **128**, 727.

The Committee on the Supply of High Explosives have issued a notice to tar distillers, etc., specifying the standard distillation test for toluene in benzol. The sample is distilled from a flask having a bulb (preferably coppered) of 150—180 c.c. capacity, a neck about 5 ins. long, and a side tube at about the middle of the neck. A water-cooled condenser, 18—20 ins. long is used, and a 100 c.c. graduated cylinder for the distillate. The flask and condenser are washed with the benzol to be tested, and 100 c.c. of benzol introduced. The rate of distillation should be two drops per second. When the corrected benzol thermometer shows 84° C. (at 30 inches pressure, or ±0·1° C. for ∓0·1 inch pressure), the apparatus is allowed to cool and the distillate read off. Any deficiency from 100 c.c, when the residue is added to the distillate is considered as distillate. If the distillate amount to more than 95% and the sp. gr. of the benzol be between 0·880 and 0·890 at 15° C., it may be sold without a permit, but if the distillate be less than 95% a sample must be submitted to the Committee for test.—W. F. F.

*Aniline oil and salt, and picric acid; Prohibition of exports of* ——. Board of Trade J., Dec. 17, 1914.

An Order in Council, dated Dec. 11th, prohibits the export to all destinations of aniline oil, aniline salt, and picric acid and its components.

*Toluol supplies and the War Office.*

The Army Council has notified the majority of British gas undertakings that for the period of the war, they are to place at the disposal of the Council their whole output in toluol or substances containing toluol (commercial benzol, light oils, etc.), so far as they are not covered by existing contracts.

*Organic substances; Addition compounds of —— with sulphuric acid.* J. Kendall and C. D. Carpenter. J. Amer. Chem. Soc., 1914, **36**, 2498—2517.

The authors have studied the action of pure sulphuric acid (100%) at low temperatures on 35 organic compounds, including aldehydes, ketones, phenols, and aromatic and aliphatic acids. From observations of the freezing points it is concluded that addition compounds of the oxonium type are formed in the majority of cases, and that sulphonation is preceded by formation of such compounds.—R. G. P.

PATENTS.

*Tar distillation products; Process for treating —— with phosphoric acid.* M. Melamid and L. Grötzinger. Ger. Pat. 276,765, Aug. 19, 1913. Addition to Ger. Pat. 264,811, Aug. 22, 1912.

THE hydrocarbons of tar oils are converted into hydrocarbons of lower boiling point by heating with phosphoric acid. For example, one kind of tar yielded 6·5% boiling up to 200° C., sp. gr. 0·950; when the tar was heated with 25% of phosphoric acid it yielded 30% boiling below 200° C. (sp. gr. 0·897), 9% up to 230° C. (0·990), 23% up to 270° C. (0·992), and 14% up to 320° C. When the oils boiling below 200° C. were again distilled with 25% of phosphoric acid, they yielded 80% of b. pt. below 120° C. (sp. gr. 0·860), 6% below 150° C. (0·807) and 14% below 180° C. (0·880); by similar treatment the fractions boiling between 200° and 270° C. yielded 20% below 120° C. (sp. gr. 0·867), 25% below 180° C. (0·884), and 55% below 230° C. (0·965). (Compare this J., 1912, 977; 1913, 415, 820, 861, 1000).—T. F. B.

*Anthraquinone; Process of making ——.* F. Singer, Offenbach, Assignor to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,119,546, Dec. 1, 1914. Date of appl., May 25, 1914.

ANTHRACENE is treated with nitric acid in presence of a mercury salt and an indifferent liquid at a temperature below 60° C., and the product thus obtained, which is a mixture of unstable mesonitro derivatives of anthracene, is converted into anthraquinone by treatment with an oxidising agent, in presence of a mercury salt, at a temperature above 60° C.—T. F. B.

*Aminoanthraquinones; Process for preparing ——.* Farbwerke vorm. Meister, Lucius, und Brüning. Fr. Pat. 469,741, May 27, 1913.

SEE U.S. Pat. 1,104,943 of 1913; this J., 1914, 855. Organic amino compounds may be used in place of ammonia.—T. F. B.

*Obtaining benzene from petroleum or its distillates.* Addition to Fr. Pat. 460,827. *See* IIA.

## IV.—COLOURING MATTERS AND DYES.

*Aniline dyes; Manufacture of —— in Great Britain.* Board of Trade, Dec., 1914.

THE Government are prepared to assist an effort to establish a factory for the large-scale manufacture of aniline dyes on the following lines:—

(*a*) A limited company to be formed with a share capital of £3,000,000, divided into 3,000,000 shares of £1 each. This capital to be subscribed by those interested, and be paid up as to 2s. 6d. a share on allotment, and 5s. on June 30th, 1915. The remaining 12s. 6d. is not likely to be needed for some time to come, and when required will only be payable in calls not exceeding 2s. 6d. a share, at intervals of not less than six months between each call.

(*b*) The Government to advance to such company £1,500,000, bearing interest at the rate of 4 per cent. per annum and secured as a first charge on the assets and undertaking of the company, and repayable in 25 years.

(*c*) The interest on the advance and a sinking fund for its repayment are to be payable only out of the net profits of the company, but are to be cumulative.

(*d*) The Government advance to be made as to £750,000 on the Government being satisfied that the £3,000,000 capital of the company has been fully subscribed, and the remaining £750,000 so soon as the call of 5s. a share has been made.

(*e*) The Government shall have the right of appointing two directors of the company, with power to veto any undue encroachment on the businesses of British manufacturers of products other than dyes and colours, or the giving of any undue preference as regards supply prices or otherwise to consumers of the company's products. The names of the gentlemen so appointed are Sir Gilbert H. Claughton, Chairman of the London and North-Western Railway Company, and Sir Frank Forbes Adam.

(*f*) The company shall remain British.

The Committee on dye supply consider that co-operation would best be secured by the subscription of the share capital by those interested, and also by a contract being entered into between the company and the consumers and users of its products whereby the consumers should agree for a period of five years after peace is established, or five years after the expiry of existing contracts and of all deliveries thereunder (whichever is the longer period), to take their supplies from the company in all cases where the company is able to supply the same of good quality and at reasonable prices, but with a provision that if a consumer should consider the prices fixed by the directors of the company too high, he may require that the prices to be charged shall be determined by an independent referee.

With the object of securing for the company impartial administration of its business as between the users of dyes, it is intended that the board of the company (other than the Government directors) shall be selected by the Committee, and mainly composed of business men who are not themselves necessarily engaged in the dyeing trade. The board will be assisted by an advisory committee, constituted from among the representatives of the users of dyes, and will, in addition, have the advantage of the advice of chemical and other experts.

The Committee have had addressed to them, among other questions, inquiries as to whether the company would not be hampered (1) by inability to secure the requisite alcohol free of duty, and (2) by restrictions at the instance of German holders of British patents. The Committee have satisfied themselves with regard to (1) that the company will be able to obtain from the Board of Customs and Excise permission to use alcohol for all industrial purposes, free from duty, by arranging that the denaturing of such alcohol shall be carried out under conditions which will not hamper its use for such purposes; and with regard to (2) that the new Act of 1914 and the rules thereunder will enable the company to obtain on reasonable terms a licence from the Board of Trade for the duration of the patents empowering it to manufacture commodities covered by such patents, so as to enable the community to enjoy the full use of the patented invention.

It is now essential for the Committee to ascertain the extent to which they can rely on the support of those interested.

PATENTS.

*Vat [anthracene] dyestuffs and intermediate products for use in making them.* Badische Anilin und Soda Fabrik. First Addition, dated Feb. 13, 1914, to Fr. Pat. 458,949, June 7, 1913. Under Int. Conv., June 28, 1913, and Jan. 6, 1914.

IMINES of anthracene-1.9-dicarboxylic acid in which the hydrogen of the imino group is replaced

by hydroxyl, alkyl, or aryl, are obtained by treating the acid or its anhydride with hydroxylamine or with a primary aliphatic or aromatic amine. The methylimine is obtained, for example, by heating anthracene-1.9-dicarboxylic anhydride with ten times its weight of 13% aqueous methylamine solution for five hours at 150° C. These substituted imines are converted into vat dyestuffs analogous to those obtained according to the principal patent (see this J., 1913, 1101), by fusion with alkalis. The dyestuffs may also be obtained by treating the dyestuffs of the principal patent with alkylating or arylating agents. In general, the products dye rather bluer shades than those from which they are derived.—T. F. B.

[*Azo*] *dyestuffs and process of manufacturing the same.* E. S. Chapin, Sharon, and E. Lesser, Boston, Assignors to American Dyewood Co., New York. U.S. Pat. 1,106,781, Aug. 11, 1914. Date of appl., Dec. 20, 1910.

A DIAZOTISED aminosulphonic acid, such as 1-naphthylamine-4-sulphonic acid, is combined with an *a*-anhydrotetramethylhæmatoxylone, an oxidation product of acetylmethylhæmatoxylin. —T. F. B.

*Wool* [*azo*] *dyes; Manufacture of brown* ——. G. B. Ellis, London. From Chemical Works, formerly Sandoz, Basle, Switzerland. Eng. Pat. 28,910, Dec. 15, 1913.

SEE Fr. Pat. 467,114 of 1914; this J., 1914, 856. —T. F. B.

*Azo dyes for the arylamides of* 2.3-[*hydr*]*oxynaphthoic acid and process of making them.* A. L. Laska and A. Zitscher, Offenbach, Assignors to Chem. Fabr. Griesheim-Elektron, Frankfort, Germany. U.S. Pat. 1,121,026, Dec. 16, 1914. Date of appl., May 11, 1914.

SEE Eng. Pat. 10,085 of 1914; this J., 1914, 915. —T. F. B.

*Compounds of leuco vat dyes with aralkyl compounds and process of making same.* K. Reinking and A. J. Stiegelmann, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen on Rhine, Germany. U.S. Pat. 1,106,970, Aug. 11, 1914. Date of appl., Sept. 28, 1910.

SEE Fr. Pat. 414,937 of 1910; this J., 1910, 1247. —T. F. B.

*Azo dyestuffs; Process for producing* ——. Farbenfabr. vorm. F. Bayer und Co. Fr. Pat. 469,457, March 9, 1914. Under Int. Conv., March 11, 1913.

SEE Ger. Pats. 274,081 and 274,082 of 1913; this J., 1914, 784.—T. F. B.

*Azo dyestuffs; Process for producing* ——. Farbenfabr. vorm. F. Bayer und Co. Fr. Pat. 469,949, March 21, 1914. Under Int. Conv., April 11, 1913.

SEE Eng. Pat. 10,380 of 1913; this J., 1914, 545. —T. F. B.

[*Azo*] *dyestuffs for half-wool or half-silk; Process for making* ——. Farbwerke vorm. Meister, Lucius, und Brüning. Fr. Pat. 469,901, May 31, 1913.

SEE Eng. Pat. 13,236 of 1913; this J., 1914, 194. —T. F. B.

*Dyestuffs of the Quinoline Yellow series; Process for making halogenated* ——. Farbwerke vorm. Meister, Lucius, und Brüning. Fr. Pat. 470,181, March 27, 1914. Under Int. Conv., May 2 and 13, 1913.

SEE Eng. Pat. 8577 of 1914; this J., 1914, 743. —T. F. B.

*Condensation products of the arylamides of* 2.3-*hydroxynaphthoic acid and azo dyestuffs derived therefrom.* Chem. Fabr. Griesheim-Elektron. Fr. Pat. 470,033, March 24, 1914. Under Int. Conv., April 19 and May 17, 1913.

SEE Eng. Pats. 3312 and 3313 of 1914; this J., 1014, 742, 855.—T. F. B.

## V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

*Cellulose; Determination of the degree of bleaching of* ——. C. G. Schwalbe. Z. angew. Chem., 1914, 27, 567—568.

IN the determination of the cupric-reducing value of cellulose (this J., 1910, 689), the limits of variation between duplicate tests should not exceed 0·2 in the "copper value," but abnormal results, *e.g.*, values ranging from 0·6 to 1·3, may be obtained through the presence of cupric-reducing impurities in the Rochelle salt or the water employed. Commercial specimens of Rochelle salt frequently contain small proportions of oxalate, which reduces the Fehling's solution on boiling and discolours the cellulose at the conclusion of the test. Cupric-reducing impurities have also been found when condensed steam contaminated with volatile oily matters was used for making up the reagents. The solutions used should always be controlled by a blank test, by adding the hot mixture of 50 c.c. of each of the ingredients of Fehling's solution to 400 c.c. of water and boiling for 15 mins. under a reflux condenser. The liquid should neither turn greenish in colour nor deposit a precipitate of cuprous oxide on standing. If pure normal cotton has been boiled with the mixture, it should show no brownish discoloration. In performing the determinations, the heating arrangements must be adjusted to avoid over-heating of the walls of the flask, as drops of the liquid thrown against the heated glass by the stirrer may be decomposed, forming products which affect the results. —J. F. B.

*The paper industry in Russia and Finland.* Papierfab., 1914, 12, 106—108, 346—348.

THE movement for the abolition of the customs barrier between Russia and Finland, if successful, will have an important influence on the pulp and paper trade, and by some it is feared the Russian paper industry may be ruined. The value of imports of wood pulp and paper from Finland into Russia has grown from 7 million roubles (1 rouble = 2s. 1½d.) in 1900 to 22 millions in 1912; the ratio of imports to home production in Russia has increased in the same period from 16·7% to 35·1%. An import duty on Finnish pulp and paper was first imposed in 1885, and since it failed to check competition, it was increased in 1897, but still without effect. The statistics for 1912 of imports from Finland show: 885,000 poods (1 pood = 36 lb.) of mechanical pulp, 995,000 of wood pulp boards, 2,000,000 of paper made from boiled wood and 4,200,000 of white paper containing mechanical pulp. In the last 6—7 years the total exports of mechanical pulp from Finland have remained stationary while the exports of paper have gone on increasing largely, and about 80% go to Russia in spite of the duty. Thus it is more profitable to Finland to make paper and pulp boards than raw pulp, and although the production of the latter has increased yearly, the increment is all absorbed in the manufacture of the former. To other countries Finland exports 1,500,000 poods of paper, 3,600,000 of cellulose, and 2,000,000 of mechanical pulp against Scandinavian competition. As the export of mechanical pulp does not increase,

although these other countries impose no duties, it is hardly probable that the removal of the Russian barrier would sensibly benefit the Russian papermaker as regards raw materials. If it did produce any considerable fall in price there would be a danger of ruining the Russian wood grinding industry which works under relative disadvantages. As regards paper, the establishment of Russian tariffs in Finland would raise the price of imported machinery, felts, and accessories, but there would still remain a balance of advantage of about 20% in favour of Finnish paper entering Russia, against which the Russian papermaker could not compete. Further, the volume of the trade would tend to increase, since the duty on accessories would cripple Finnish competition with Scandinavian paper. Finland possesses many industrial advantages over Russia: abundant water power, amounting to 97% of the total in mechanical pulp production and 80% in the paper industry, cheap water transport, good harbours, organised water rights, dense and educated population. The Russian industry consumes a large proportion of fuel, mostly wood and imported coal. The free export of pulp wood raises the price of the material and much of it goes to Germany, whereas in Finland there is an export duty on wood. The Russian industry, moreover, is more affected by the price of wood owing to lack of water power, and, compared with Finland, 3—4 times as much wood is consumed in the production of a ton of pulp.
—J. F. B.

*Paper and rag pulp mill; Effect of the waste waters of a fine —— on health.* Papierfab., 1914, **12**, 70—71.

IN the case of a mill discharging about 4·5 cb. m. of waste water per min. into a stream running at the rate of 2·5 cb. m. per sec., comparative analyses of the original river water and the waste water taken at the point of discharge showed an increase in the total dry residue from 8·56 to 8·99 grms. per hl.; the organic matter increased from 2·16 to 2·64; increases were also recorded in the lime, magnesia, chlorine, sulphuric and phosphoric acids and decreases in the iron oxide, alumina, and silica. The principal increase was in the sediment, which rose from 0·082 to 2·47, consisting chiefly of fibre debris, calcium carbonate, and inert mineral matter, together with aluminium and calcium resinates from the sizing. The waste waters showed a slightly alkaline reaction owing to the presence of lime, whereas the original water was neutral. It is concluded that none of these substances could be injurious to health, and the danger of infection from rag washing would be removed by the chemical treatment employed. A certain amount of mud would be deposited as the result of the discharge, but this would consist only of calcium carbonate and iron and aluminium compounds.—J. F. B.

*Collodion enamels for leather.* Callan. *See* XV.

PATENTS.

*Wool; Method for the purification of raw ——.* F. Koch, Berlin, Germany. U.S. Pat. 1,117,194, Nov. 17, 1914. Date of appl., June 17, 1914.

RAW wool is extracted with a chlorinated hydrocarbon solvent, *e.g.* ethylene dichloride, and the remaining impurities are removed by rubbing, beating, or equivalent dry mechanical treatment.
—J. F. B.

*Plant tissues; Process for dissolving the incrusting matters of cellular ——.* E. Lubarski. Fr. Pat. 469,669, March 14, 1914.

WOOD in the form of small chips is boiled with a 10—15% solution of resin or other soap of an alkali base for 24—36 hours at atmospheric pressure or for a shorter time under a pressure of 2—3 atmos., until the tissues are sufficiently softened to enable the mass to be disintegrated to a pulp.
—J. F. B.

*Textile materials; Treatment of crude ——.* J. Meister. Fr. Pat. 470,128, March 21, 1914. Under Int. Conv., Sept. 25, 1913.

THE crude materials, vegetable fibres or silk, are treated at about 60° C. with a weak alkaline solution which may contain borax and ammonia, and then digested with a solution of pancreatic enzyme also containing horax, ammonia, and sodium chloride at 40°—50° C., for 5—20 hours. Instead of pancreatic secretions, industrial enzymes or cultures of bacteria having a similar effect may be employed, and hydrogen peroxide may be added to the enzyme bath.—J. F. B.

*Viscose; Process of treating [coagulating] ——.* D. E. Reid, Assignor to Eastman Kodak Co., Rochester, N.Y. U.S. Pat. 1,117,604, Nov. 17, 1914. Date of appl., Feb. 21, 1914.

VISCOSE is treated with a saturated solution of sodium sulphite and then with several separate baths containing gradually decreasing percentages of sodium sulphite; the sulphite is removed and the material rendered insoluble. After the treatment with sodium sulphite the material may be subjected to the successive actions of ammonium sulphate and an acid. In making films or filaments the surface of the viscose may be set by heating before coagulation.—J. F. B.

*Pyroxylin solvent.* F. Kniffen, Assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. U.S. Pat. 1,118,498, Dec. 1, 1914. Date of appl., Oct. 28, 1912.

THE solvent consists of substantially equal parts of ethyl acetate and benzene.—J. F. B.

*Cellulose; Treatment of threads of regenerated ——.* P. Joliot. Fr. Pat. 469,446, May 21, 1913.

THREADS composed of continuous or discontinuous filaments of regenerated cellulose are strengthened by first converting them into alkali-cellulose by immersion for a few minutes in caustic soda solution, then exposing them to the action of carbon bisulphide, and regenerating the cellulose by decomposing the xanthogenate without dissolving it.—J. F. B.

*Nitrocellulose [from wood pulp] specially suitable for the manufacture of celluloid; Preparation of ——.* K. Schonlau. Fr. Pat. 469,484, March 11, 1914. Under Int. Conv., April 28, 1913.

WOOD cellulose, manufactured either by the sulphite or the soda process, is bleached and treated in a beating engine with a hot mixture of water and oil of turpentine to remove the resins and other incrusting matters. The pulp is then made into a cellulose wadding formed of thin layers, which is dried at a moderate temperature before nitration. For 1 kilo. of cellulose a mixture consisting of at least 4 kilos. of 61% $HNO_3$ and 9·3 kilos. of 93·5% $H_2SO_4$ is employed.—J. F. B.

*Artificial silk; Tube for use in the manufacture of ——.* F. Mancelin. Fr. Pat. 469,890, March 20, 1914.

THE tube for use in the coagulation of artificial threads is constructed of a metal or alloy. It has a funnel at its upper end, with or without constrictions in the internal diameter of its cylindrical portion, and terminates in a bell mouth with rounded edges where the thread issues from the bottom.—J. F. B.

*Cellulose derivatives; Manufacture of plastic substances from* ——. F. Lehmann. Fr. Pat. 469,925, March 21, 1914. Under Int. Conv., March 25, 1913.

CELLULOSE esters are incorporated by the aid of solvents with coumarone resin consisting of the resinous products formed by the polymerisation of coumarone and indene in the refining of coal-tar oils. Example:—200 grms. of coumarone resin are dissolved in a mixture of 100 grms. each of ether, alcohol, and benzene, and 700 grms. of nitrocellulose are incorporated with the solution in a manner similar to that employed in the manufacture of plastic masses containing camphor.
—J. F. B.

*Cellulose; Manufacture of lustrous threads of* ——. P. Joliot. Fr. Pat. 470,141, March 25, 1914.

CELLULOSE yarns are converted into alkali-cellulose and exposed *in vacuo* to the action of carbon bisulphide vapour; the threads are then stretched to their original length and the xanthogenate is decomposed by the usual methods. The regenerated cellulose is purified by treatment in a bath of sodium sulphide at about 70° C. The lustre of the threads may be increased by repeating the series of treatments.—J. F. B.

*Paper having relief-like effects; Manufacture on the paper-machine of* ——. Farbwerke vorm. Meister, Lucius, und Brüning. Fr. Pat. 469,358, March 6, 1914. Under Int. Conv., April 18, 1913.

THE wet web of paper on the machine wire, on which relief effects have been produced, *e.g.* mechanically according to Eng. Pat. 10,529 of 1908 (this J., 1908, 1130), is sprayed from above with dilute solutions of colouring matters, which may consist of the coloured backwaters which have already drained through the wire, or of solutions of different colours, specially prepared, which may contain coloured fibres, mica, etc., in suspension. These liquids settle in the hollows of the relief and produce deeper or different colours in the pattern.—J. F. B.

*Sulphite cellulose waste lye; Treatment* [*alcoholic fermentation*] *of* ——. G. T. Onsager, Drammen, Norway. Eng. Pat. 24,738, Oct. 30, 1913.

THE waste lye is subjected to alcoholic fermentation in presence of a yeast nutrient derived from milk sugar and made, for example, in the following manner:—1 litre of the lye, mixed with 1 litre of skimmed milk, is slightly acidified with sulphuric acid and heated to about 50° C.; the precipitate of casein and lignin compound is removed by filtration and the filtrate mixed with 299 litres of the waste lye. The mixture is boiled until about ½ of its volume has evaporated and the milk sugar is hydrolysed; the liquor is then neutralised with calcium carbonate, cooled to 28° C. and sown with waste brewer's yeast in the proportion of about 400 c.c. per 100 litres.—J. F. B.

*Balloon fabric and the like.* B. J. D. Porritt, Assignor to North British Rubber Co., Ltd., Edinburgh. U.S. Pat. 1,118,149, Nov. 24, 1914. Date of appl., Feb. 11, 1913.

SEE Eng. Pat. 1972 of 1913; this J., 1914, 132.
—T. F. B.

*Artificial thread; Manufacture of* ——. J. C. Hartogs, Amsterdam, Assignor to N. V. Nederlandsche Kunstzijdefabriek, Vosdijk Arnhem, Netherlands. U.S. Pat. 1,119,155, Dec. 1, 1914. Date of appl., July 26, 1911.

SEE Ger. Pat. 237,744 of 1910; this J., 1911, 1249.
—T. F. B.

*Textile fibres; Process of softening* ——. C. Marx, Lambrecht, Germany. U.S. Pat. 1,120,730, Dec. 15, 1914. Date of appl., June 3, 1910.

SEE Eng. Pat. 8523 of 1910; this J., 1911, 614.
—T. F. B.

*Peat, wood-waste, and other vegetable substances suitable for the manufacture of paper pulp; Process for rendering* ——. W. Hellwig, Münstereifel, Germany. U.S. Pat. 1,121,099, Dec. 15, 1914. Date of appl., Dec. 16, 1912.

SEE Eng. Pat. 28,489 of 1911; this J., 1912, 1075.
—T. F. B.

*Regeneration of impure benzene.* Fr. Pat. 469,490. *See* IIA.

*Manufacture of fodder from waste sulphite cellulose lyes.* Fr. Pat. 469,768. *See* XIXA.

## VI.—BLEACHING; DYEING; PRINTING; FINISHING.

*Skins; Preparation and dyeing of* ——. F. König. Z. angew. Chem., 1914, **27**, 529—532.

A GENERAL account of the dyeing of fur skins, describing the use of both natural and artificial dyestuffs.—F. C. T.

### PATENTS.

*Bleaching, disinfecting, deodorising, or preserving agent; [Electrolytically] producing a* ——. J. T. Niblett, Denmark Hill. Eng. Pat. 26,726, Nov. 20, 1913.

A CLOSED electrolytic chamber is connected with a fan or blower, and air charged with the gases liberated during electrolysis (of a halogen compound or potassium disulphide) is passed through a heater or cooler, and then through a drying chamber before being passed into the closed chamber containing the material to be treated.
—B. N.

*Bleaching vegetable or animal textile fibres in a spun, woven, or other suitable form; Use of ultra-violet rays for* ——. J. L. Pech. Fr. Pat. 469,300, Feb. 17, 1914.

THE moistened fibres, in contact with air, are exposed to ultra-violet rays produced artificially.
—B. N.

*Mercerising cotton; Process of* ——, *which gives a very regular mercerisation without preliminary boiling of the fibre.* G. Boudin. Fr. Pat. 469,242, May 14, 1913.

RAW cotton or other vegetable fibre is treated, without preliminary boiling, with caustic soda to which has been added a certain quantity of alcohol, oil of turpentine, benzene, or other suitable hydrocarbon.—B. N.

*Dyeing and like machinery; Compact* ——. J., T., and E. Brandwood, Bury, Lancs. Eng. Pat. 17,219, July 21, 1914.

THE apparatus comprises a dyeing chamber, with two turbine pumps in communication with it and also connected by pipes with a reserve tank for the dye-liquor. The pumps are driven alternately by a common motor.—B. N.

*Dyeing and like apparatus; Perforated beams for* ——. J., T., and E. Brandwood, Bury, Lancs. Eng. Pat. 17,355, July 22, 1914.

THE perforated beam, on which the yarns are dyed, is provided with iron flanges at each end, each flange being faced on its inner surface with a thin covering plate of nickel, ebonite, etc., of smaller diameter than the flange. The edges of the facing are spun or pressed over into contact with the iron foundation, so as to form fluid-tight joints. —B. N.

*Dyeing vegetable fabrics; Process of lisleing and* ——. A. N. Duhois, Philadelphia, Pa. U.S. Pat. 1,116,397, Nov. 10, 1914. Date of appl., Dec. 2, 1909.

THE material is boiled sufficiently to render it absorbent, washed, hydro-extracted, saturated with a carbonising solution containing alum, starch, hydrochloric acid, and iron sulphate for 15 to 20 minutes, and afterwards again hydro-extracted so as to leave in the material solution equal to 50 to 60% of the dry weight of the goods. It is then subjected to heat and attrition at 110° to 120° F. (43° to 49° C.), until the surface has the desired lisle-thread finish, treated with a neutralising, dyeing and fixing solution, washed, hydro-extracted, and dried.—B. N.

*Dyeing hanks, notably of silk; Tissue-envelope for* ——. R. von der Linde. Fr. Pat. 469,795, Feb. 28, 1914.

THE envelope is formed of a material with a large mesh, strengthened on its longitudinal or transverse edges or at other points by bands of suitable material offering a great resistance to movements during dyeing. The bands are furnished with pressure studs as a convenient mode of fastening. —B. N.

*Aniline Black; Production of ungreenable* ——. E. Grandmougin and E. Havas. Ger. Pat. 275,845, May 10, 1913.

THE mineral acid used in the ordinary Aniline Black process is partly replaced by a strong organic acid (*e.g.*, lactic, formic, or glycollic acid), and the colour is developed by steaming. The following quantities are given for use in cotton printing: 700 grms. of starch-tragacanth thickening, 45 grms. of aniline salt, and 30 grms. of potassium ferrocyanide are dissolved in water, 35 grms. of sodium chlorate and 80 c.c. of water are added and then 55 grms. of aniline and 55 grms. of 50% lactic acid; this mixture is printed on the fabric which is then dried, steamed in the Mather-Platt, rinsed, and soaped.—T. F. B.

*Vegetable fibre effects; Manufacture of tissues of all kinds, dyed in the piece, with* ——. P. Caminada and P. Ruggeri. Fr. Pat. 469,250, March 4, 1914. Under Int. Conv., March 18, 1913.

THE fibres are treated, before weaving, with a mixture of 15 parts of nitric acid (sp. gr. 1·5) and 85 parts of sulphuric acid (sp. gr. 1·84), washed, dried, passed through a bath of 20% calcium acetate and 15% albumin, dried, then treated in a solution of sodium stannate (sp. gr. 1·116), dried, and finally passed through a 10% solution of ammonium chloride. The prepared fibres do not take the dyestuff when dyed in the piece.—B. N.

*Printing; Producing woven effects by* ——. Soc. des Manufactures N. N. Konchine. Fr. Pat. 469,371, March 7, 1914.

CELLULOSE and its derivatives, dissolved in suitable solvents, are printed on the tissue by means of an engraved roller, and a precipitating liquid for the cellulose is delivered on to the roller.—B. N.

*Dyeing of fabrics and fibres with Aniline Black by oxidation in the air.* H. Fletcher, Thaon-les-Vosges, Assignor to A. E. Vergé, Vincennes France. U.S. Pat. 1,119,075, Dec. 1, 1914. Date of appl., Aug. 20, 1913.

SEE Eng. Pat. 18,246 of 1913; this J., 1914, 747. —T. F. B.

*Gallocyanines and their leuco derivatives on cotton fabrics; Process for applying a reserve for* ——. Manuf. de Mat. Col. anc. L. Durand, Huguenin et Cie. Fr. Pat. 469,960, March 21, 1914. Under Int. Conv., May 2, 1913.

SEE Ger. Pat. 269,933 of 1913; this J., 1914, 418. —T. F. B.

## VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

*Potash salts; Working up of the materials obtained by the electrolysis of the residual liquors from the manufacture of* ——. Dietz. Z. angew. Chem., 1914, 27, 569—572.

BESIDES bromine and hydrogen there are obtained at the anode chlorine, on the cathode an incrustation of magnesium hydroxide, and in the cathode compartment a precipitate of magnesium oxychloride. The incrustation is preferably treated separately from the precipitate, and by washing and heating may be profitably converted into oxide or hydroxide free from chlorine. The oxychloride may be treated by the Leopoldshall process with steam to produce magnesia and hydrochloric acid; but preferably it is centrifuged and ignited to anhydrous oxychloride, $MgCl_2,6MgO$, which is used as magnesia cement. The chlorine may be converted into hydrochloric acid either by decomposing the chlorides of zinc or aluminium with steam, and then regenerating the chloride by passing chlorine and hydrogen over the hydroxide thus formed (Hoppe, Fr. Pat. 352,419; this J., 1905, 925), by Patacky's method (Ger. Pat. 114,129; see Eng. Pat. 1831 of 1900, this J., 1900, 349), or by Nagel's method (this J., 1912, 126). Preference is given to the first-named process.—G. F. M.

*Potassium permanganate; Notes on the use of* —— *as cyanicide in sand-filling solutions.* R. A. Cooper. J. Chem., Met., and Min. Soc., S. Africa, 1914, 15, 70—72.

TESTS were made of the action of potassium permanganate on normal solution from sand-filling plant containing 0·0013% KCN and 0·0015% KCNS, and on solutions of sodium cyanide (strength equivalent to 0·002% KCN), sodium thiocyanate (0·002% KCN), and sodium-zinc cyanide (0·002% KCN) respectively. The first three solutions were considerably affected by the permanganate, but the reaction was still incomplete after four days. The sodium-zinc cyanide, which is present in large proportion in working solutions, appeared to be only slightly, if at all, affected by the permanganate after four days contact.—T. ST.

*Cyanide mud; Critical investigation of the methods for the determination of Prussian blue in* ——. G. Anderson. Z. angew. Chem., 1914, 27, 532—535.

THE methods of Bueb (Bunte, "Zum Gaskursus," 1912), Drehschmidt (J. Gasbeleucht., 1892, 225)

and Feld-Witzeck (this J., 1904, 728) were investigated. The chief disadvantage of the first method is the lack of a sharp end-point in the titration of ferrocyanide with zinc sulphate. Dilution or the addition of sulphuric acid causes differences in the titration results. The Drehschmidt method proved to be the least accurate of the three. The use of mercurous nitrate to remove chlorine is not satisfactory. The Feld-Witzeck method is rapid and reliable; the author has used it for two years and found it satisfactory. The Bueb method gives rather lower results than the others. —F. C. T.

*Limestone; Production and uses of —— in U.S.A.* E. C. Eckel. Eng. and Min. J., 1914, **98**, 899.

THE consumption of limestone in the United States in 1912 and 1913 was:—

| Used for | Million short tons. | |
|---|---|---|
| | 1912. | 1913. |
| Road metal, ballast, concrete | 33·1 | 35·2 |
| Blast-furnace flux | 22·6 | 25·3 |
| Portland cement manufacture | 18·5 | 20·7 |
| Lime-burning | 6·3 | 6·4 |
| Building and paving stones | 3·7 | 3·3 |
| Sold crude, chiefly for lime-burning | 2·0 | 2·0 |
| Natural cement manufacture | 0·15 | 0·13 |
| Total output | 86·4 | 93·1 |

—O. E. M.

*Barium cyanide; Action of steam on ——.* L. Rolla. Annali Chim. Appl., 1914, **2**, 301—304.

ONE of the processes suggested for the fixation of atmospheric nitrogen consists in passing air over a mixture of barium oxide and carbon heated to above 1000° C., and decomposing the resulting mixture of barium cyanide and cyanamide with steam to obtain ammonia. To ascertain the character of the combustible gases produced in the second stage of the process, pure barium cyanide was heated in nitrogen to various temperatures and then treated with steam, and the products analysed. In the following tables the quantities of the different gases are given in c.c. per grm. of ammonia produced:—

| Temperature. | CO | $H_2$ | $CH_4$ | $CO_2$ |
|---|---|---|---|---|
| °C. | | | | |
| 100 | 300·2 | — | — | — |
| 150 | 341·4 | — | — | — |
| 200 | 459·2 | — | — | — |
| 250 | 274·5 | 903·6 | — | 58·9 |
| 300 | 289·4 | 1118·5 | — | 74·7 |
| 350 | 200·1 | 398·9 | 211·1 | 59·4 |
| 370 | 165·0 | 701·6 | 400·8 | 65·4 |
| 400 | 179·7 | 994·3 | — | 88·8 |
| 450 | 214·0 | 1084·6 | — | 86·1 |
| 500 | 221·5 | 1153·6 | — | 94·2 |

Gas of the maximum calorific value is thus produced between 300° and 400° C. Probably barium formate is formed as intermediate product of the reaction and is decomposed in various ways according to the conditions.—A. S.

*Cuprous and cupric sulphides; Determination of —— in mixtures of one another.* E. Posnjak. J. Amer. Chem. Soc., 1914, **36**, 2475—2479.

THE substance (0·4—0·5 grm.) ground to pass a 100-mesh sieve is heated with 50 c.c. of 5% silver nitrate solution for about 3 hrs. on the steam bath with frequent vigorous stirring. The following reactions take place:—

$$Cu_2S + 4AgNO_3 = Ag_2S + 2Ag + 2Cu(NO_3)_2$$
$$CuS + 2AgNO_3 = Ag_2S + Cu(NO_3)_2.$$

The resulting mixture of silver and silver sulphide is filtered off, washed free from silver nitrate, and metallic silver extracted by treating two or three times with 40—50 c.c. of 5% solution of ferric nitrate (anhydrous) at about 70° C., and the silver in the solution and in the residue determined. The amount of cuprous sulphide can then be calculated from the amount of silver formed, and the cupric sulphide from the difference between the silver as sulphide and metallic silver. The method is accurate in mixtures of all proportions to within 1·5%.—R. G. P.

*Tungstic acid; Modifications of the reduction test for ——.* G. Torossian. Amer. J. Sci., 1914, **38**, 537—538.

THE tests for tungstic acid in solutions with zinc, tin, or aluminium in presence of hydrochloric acid, are made more sensitive by using the substance to be tested in solid form. If the dry or moistened substance be rubbed with a piece of iron or aluminium, a blue coating appears on the metal if no strong oxidising agents are present. The test fails in the presence of chromates, chlorates, or nitrates. Several modifications of the acid test are described, the following being recommended: (*a*) The powdered substance is placed on aluminium foil, moistened with water and a drop of hydrochloric acid added. The blue colour is developed even in the presence of oxidising agents. (*b*) A globule of water is placed on aluminium foil, the powdered substance is sprinkled upon it, and a small drop of hydrochloric acid added. The production of the blue colour is not prevented by carbonaceous matter, metallic oxides, sulphur, or calcium fluoride.—W. F. F.

*Sodium nitrate. Shipments and consumption from 1912 to 1914.* W. Montgomery and Co. Dec. 31, 1914.

| 12 months ending Dec. 31st. | 1912. | 1913. | 1914. |
|---|---|---|---|
| | Tons. | Tons. | Tons. |
| Shipments from South American Ports to all parts | 2,456,000 | 2,647,000 | 2,660,000 |
| Consumption in U.K. | 132,000 | 125,000 | 122,000 |
| Consumption in Continent | *1,711,000 | *1,689,000 | *1,868,000 |
| Consumption in United States | 503,000 | 583,000 | 553,000 |
| Consumption in other Countries | *114,000 | *86,000 | *90,000 |
| Consumption in the world | 2,460,000 | 2,451,000 | 2,633,000 |

* Egypt, which has hitherto been included in "Other Countries" is now included in figures for the Continent.

*Ammonium chloride as a by-product of coke-ovens, gas-works, etc.* Strommenger. *See* IIA.

## PATENTS.

*Ammonia from its elements; Catalytic manufacture of ——.* Badische Anilin und Soda Fabrik. Ger. Pat. 276,133, Nov. 30, 1912. Addition to Ger. Pat. 249,447.

IN processes for the catalytic production of ammonia, in which the catalyst consists of a contact metal and an "activator," one of which absorbs hydrogen and the other nitrogen, it is possible to minimise, or even to eliminate the influence of contact poisons by working at a comparatively low temperature. Thus, when a mixture of reduced iron with 5% of aluminium borate is used as catalyst, satisfactory yields of ammonia are obtained at about 500° C., whilst with aluminium phosphate about 450° C. is suitable; in this latter case, the "poisonous" effect of the phosphorus is not apparent much below 600° C.—T. F. B.

*Ammonia obtained from cyanamide; Catalytic oxidation of —— by means of air or other gas containing oxygen.* Oesterr. Verein f. Chem. u. Metall. Produktion. Ger. Pat. 276,720, Nov. 8, 1913.

THE crude ammonia obtained from cyanamide is washed with an alkali or alkaline-earth hydroxide. This removes from it the silicious dust and also the hydrides of silicon and phosphorus and acetylene, which are decomposed during the catalytic oxidation and thus act as contact poisons.—T. F. B.

*Cyanides and other useful products [calcium cyanamide]; Manufacture of ——.* C. White, London. Eng. Pat. 17,937, Aug. 6, 1913.

A MIXTURE of calcium carbide with not less than 25% of sodium or potassium chloride or carbonate, or of a mixture of these, is heated in a current of nitrogen, and the reaction mass, containing alkali cyanide and calcium cyanamide, is lixiviated, the residual cyanamide being pressed and dried, preferably at a low temperature, or heated in a current of steam to produce ammonia. For example, nitrogen is passed for 12—24 hours, at 10 lb. above atmospheric pressure, over a mixture of carbide (14 parts) and dry sodium chloride (20 parts), heated to 750°—900° C.—F. SODN.

*Sulphurous anhydride and carbonic anhydride; Apparatus for the purification of gases rich in ——.* L. P. Basset, Montmorency, France. Eng. Pat. 20,667, Sept. 12, 1913.

THE gases pass successively through a dust chamber, the tubes of a boiler, a washer, and a scrubber in which the sulphur dioxide or carbon dioxide is absorbed by sprayed water or other liquid and from which the liquor passes into the boiler, where it serves to cool the gases passing through the boiler-tubes, whilst at the same time the dissolved gas is expelled. A heat-exchange apparatus heats the liquor on its way to the boiler and cools the returning liquor before this passes to the reservoir to be pumped back to the top of the scrubber. A separate small quantity of water is circulated repeatedly through the washer, so that little gas is absorbed at this stage. A coiled tube in the dust chamber may serve to heat air, which is then used to regulate the atmosphere of the furnace in which the gases are produced.—F. SODN.

*Sulphur; Process and apparatus for the commercial extraction of —— from gases rich in sulphurous anhydride.* L. P. Basset, Montmorency, France. Eng. Pat. 20,716, Sept. 13, 1913.

THE gases, previously purified and freed from dust, are passed into a column containing incandescent coke, and the resulting mixture of carbon bisulphide, oxysulphide, and monoxide is then oxidised to sulphur and carbon dioxide in a second chamber, contiguous to and heated by the first, by treatment with an excess of sulphur dioxide admitted through a separate conduit. The second chamber is fitted with baffles, and the desired temperature is maintained in both chambers by lagging the sides and, if necessary, preheating the gases.
—F. SODN.

*Molybdenum trioxide from ores and concentrates; Process for recovering ——.* F. D. S. Robertson, Glasgow. *Eng. Pat. 28,069, Dec. 5, 1913.*

THE crushed material is heated, *e.g.*, in a rotary furnace, in a highly oxidising atmosphere, preferably of air and steam, so as to produce molybdenum trioxide which is collected as a crystalline sublimate. The process may be accelerated in some cases by mixing crushed quartz or sand with the charge or, especially with pyritic ores, by adding lime which also combines with the sulphur separated; it may be repeated if further purification be desired.—F. SODN.

*Rare earths, together with thorium, cerium, and zirconium; Method of separating ——, by electrolysis.* L. M. Dennis, Ithaca, N.Y. U.S. Pat. 1,115,513, Nov. 3, 1914. Date of appl., Sept. 18, 1913.

RARE-EARTH metals are separated as insoluble compounds, from solutions containing them, by electrolytic precipitation under conditions which tend to prevent the formation of an adherent deposit of electropositive products on the cathode. Fractional separation is effected by adjusting the voltage.—F. SODN.

*Zeolites; Process of producing reactive ——.* T. R. Duggan, Assignor to The Permutit Co., New York. U.S. Pat. 1,116,038, Nov. 3, 1914. Date of appl., July 12, 1913.

A FUSED vitreous melt comprising alumina, silica, potash, and soda (the last two approximately in the ratio 1 : 5) is granulated, preferably to a size between 1·5 and 9 mm. diameter, treated with water to extract alkalis, and crushed to material of about a 2 mm. mesh. Or, the melt is crushed to the first size given, treated with hot water to destroy its vitreous character, and then re-crushed, washed, and dried.—F. SODN.

*Algae; Process for utilising marine ——.* Norsk Tangsyndikat. Fr. Pat. 469,190, Feb. 27, 1914. Under Int. Conv., March 1, 1913.

MARINE algæ are lixiviated with water on the counter-current principle, and the solution is evaporated under reduced pressure, yielding a residue containing iodine and magnesium compounds, mannitol, mucous substances, and "kreftine."—F. C. T.

*Iodine and by-products or fertilisers; Treatment of seaweed to obtain — —.* H. E. J. Roussel and L. J. C. C. Thévenin. Fr. Pat. 469,324, May 16, 1913.

THE seaweed is burnt in a pit or furnace provided with a channel, covered with metal plates on which wet weed is dried, and volatile compounds deposited in the channel are recovered. The ash or kelp obtained is systematically extracted with hot water, from which salts are deposited on cooling, and the mother liquors are treated with sulphuric acid saturated with nitrous acid, and the mixture agitated until all the iodine is precipitated.
—W. C. H.

*Hydrogen or gaseous mixtures containing it; Process for promoting the reaction of —— under pressure and at high temperatures.* Centralstelle für wissenschaftlich-technische Untersuchungen G. m. b. H. Fr. Pat. 469,391 and First Addition thereto, March 7, 1914. Under Int. Conv., April 18 and Nov. 12, 1913.

REACTIONS in which hydrogen is involved under pressure and at high temperatures are carried out in an apparatus comprising an exterior (metallic) receiver, capable of supporting the pressure, and an interior receiver (*e.g.*, of glazed porcelain, glass, quartz, etc.), capable of resisting the chemical action and the diffusion of the hydrogen. Or, the reaction is allowed to take place in an inner metallic or non-metallic porous receiver which is separated from the outer wall supporting the pressure, by an alloy or composition capable of resisting the chemical action and diffusion of the hydrogen. The process is applicable to the synthesis of ammonia.—W. C. H.

*Air into oxygen and nitrogen; Process for decomposing* ——. H. Runge. Fr. Pat. 469,793, Feb. 19, 1914.

To obtain an increased yield of oxygen, the air is dialysed, by aspiration through a suitable membrane, before being brought into the liquefying and rectifying plant.—W. C. H.

*Ammonia-soda process.* A. Clemm, Mannheim, Germany. U.S. Pat. 1,118,332, Nov. 24, 1914. Date of appl., July 24, 1913.

SEE Eng. Pat. 16,470 of 1913; this J., 1913, 1066. —T. F. B.

*Ammonia; Producing* ——. C. Bosch and A. Mittasch, Assignors to Badische Anilin und Soda Fabrik, Ludwigshafen on Rhine, Germany. U.S. Pat. 1,118,628, Nov. 24, 1914. Date of appl., Aug. 16, 1912.

SEE Addition of May 24, 1912, to Fr. Pat. 425,099; this J., 1912, 1125.—T. F. B.

*Ammonia; Method for the preparation of —— from the elements.* M. Pier, Zehlendorf-Berlin, Assignor to Dynamit A.-G., Hamburg, Germany. U.S. Pat. 1,119,534, Dec. 1, 1914. Date of appl., Oct. 5, 1912.

SEE Ger. Pat. 252,997 of 1912; this J., 1912, 1178. —T. F. B.

*Ammoniacal liquor from gas works; Process for treating* ——. Berlin-Anhaltische Maschinenbau-A.-G. Fr. Pat. 470,117, Feb. 28, 1914. Under Int. Conv., May 9, 1913.

SEE Ger. Pat. 269,658 of 1913; this J., 1914, 685. —T. F. B.

*Molybdenum [as trioxide]; Process for recovering —— from its ores and concentrates.* F. D. S. Robertson, Toronto, Assignor to M. J. O'Brien, Renfrew, Ont. U.S. Pat. 1,118,150, Nov. 24, 1914. Date of appl., Nov. 14, 1913.

SEE Eng. Pat. 28,069 of 1913; preceding.—T.F.B.

*Zinc oxide; Process of producing pure* ——. H. W. de Stucklé, Paris. U.S. Pat. 1,118,894, Nov. 24, 1914. Date of appl., Feb. 18, 1914.

SEE Fr. Pat. 465,816 of 1913; this J., 1914, 599. —T. F. B.

*Alumino-silicates; Process of producing* ——. R. Gans, Grünewald, Assignor to Permutit-Akt-Ges., Berlin. U.S. Pat. 1,121,190, Dec. 15, 1914. Date of Appl., Oct. 16, 1913.

SEE Fr. Pat. 467,038 of 1914; this J., 1914, 865. —T. F. B.

*Liquids which contain colloidal silicic acid as an impurity; Process for purifying* ——. H. W. de Stucklé, Paris. U.S. Pat. 1,118,895, Nov. 24, 1914. Date of appl., Feb. 18, 1914.

SEE Fr. Pat. 465,817 of 1913; this J., 1914, 645. —T. F. B.

*Oxide of tin; Process of making pure* ——. G. Spitz, Brünn, Austria-Hungary, Assignor to Goldschmidt Detinning Co., New York. U.S. Pat. 1,119,547, Dec. 1, 1914. Date of appl., Nov. 6, 1909.

SEE Eng. Pat. 28,565 of 1908; this J., 1910, 352. —T. F. B.

*Radiothorium; Process for extracting* ——. O. Knöfler und Co. Fr. Pat. 469,561, May 24, 1913.

SEE U.S. Pat. 1,076,141 of 1913; this J., 1913, 1116.—T. F. B.

*Electrolysis and treatment of sulphate solutions; Process for the* ——. Chance and Hunt, Ltd. Fr. Pat. 469,730, March 17, 1914. Under Int. Conv., May 19, 1913.

SEE Eng. Pats. 11,634 of 1913 and 2952 of 1914; this J., 1914, 692.—T. F. B.

*Hydrogen; Process of producing* ——. B. Spitzer, Berlin-Wilmersdorf, Assignor to Berlin-Anhaltische Maschinenbau A.-G., Berlin. U.S. Pat. 1,118,595, Nov. 24, 1914. Date of appl., March 12, 1914.

SEE Eng. Pat. 6155 of 1914; this J., 1914, 920. —T. F. B.

*Hydrogen; Process for making* ——. L'Hydrogène Soc. Anon. Fr. Pat. 469,489, March 11, 1914. Under Int. Conv., March 12, 1913.

SEE Eng. Pat. 6155 of 1914; this J., 1914, 920. —T. F. B.

*Hydrogen; Process of producing the materials for generating* ——. S. Uyeno, Tokyo. U.S. Pat. 1,120,768, Dec. 15, 1914. Date of appl., June 4, 1912.

SEE Eng. Pat. 11,838 of 1912; this J., 1913, 289. —T. F. B.

*Hydrogen; Manufacture of —— by partial liquefaction of water-gas.* L'Air Liquide (Soc. Anon. pour l'Etude et l'Explot. des Proc. G. Claude). Fr. Pat. 469,854, May 29, 1913.

SEE Eng. Pat. 13,160 of 1914; this J., 1914, 1149. —T. F. B.

*Oxygen; Separation of —— from the air.* L. Bergfeld, Durlach, Germany. U.S. Pat. 1,120,436, Dec. 8, 1914. Date of appl., Sept. 30, 1913.

SEE Eng. Pat. 21,211 of 1913; this J., 1914, 831. —T. F. B.

*Nitrogen; Process for fixing —— by means of ferro-aluminium.* Soc. Générale des Nitrures. Fr. Pat. 470,099, June 7, 1913.

SEE Eng. Pat. 27,030 of 1913; this J., 1914, 549. —T. F. B.

## VIII.—GLASS; CERAMICS.

*Ceramic industry; New technical methods in the* ——. R. Dietz. Z. angew. Chem., 1914, 27, 491—497.

A BRIEF survey of recent improvements. Amongst raw materials, geyserite and quartzspar have been found in large quantities in Germany, and are being worked in order to replace the supplies from New Zealand and Yellowstone Park (U.S.A.) in the first case, and from Norway in the second. Geyserite, pearl-sinter, or sand-sinter, from Taunus contains 99·25% $SiO_2$. Quartzspar from Zobten consists of felspar 66·96, quartz 25·28, and clay-substance 7·76%. Mined from a biotite-granite, it contains some iron which is, however, not deleterious in an oxidising fire. Another substance used as a flux is artificial sodium silicofluoride. In the preparation of raw materials, grading is effected by pneumatic separators. Clay is purified from iron by treatment with small quantities of cold hydrosulphurous acid, instead of by larger quantities of hot hydrochloric or sulphurous acid. Electro-osmosis is also employed for the purification of clay. The casting process has been so improved that it can be used for the thinnest porcelain or

the thickest lavatory basins. By the use of gas-firing a stoneware kiln capable of holding goods to the value of £400 may be fired for less than £10. The Faugeron and Dressler tunnel-kilns are noticed. Serapis faience is an underglaze treatment of stoneware and similar bodies. Gold and platinum are being increasingly used for lilac and red colours. In connection with factory hygiene, Eckstein's radiators for heating and ventilating are described (Ger. Pat. 202,846 of 1907).

—H. H. S.

PATENTS.

*Ceramic substances; Process to lower the vitrifying-point of* ——. B. Schwerin, Assignor to Ges. f. Elektro-Osmose m. b. H., Frankfort, Germany. U.S. Pat. 1,121,408, Dec. 15, 1914. Date of appl., Feb. 29, 1913.

SEE Addition of June 22, 1912, to Fr. Pat. 426,072 of 1911; this J., 1912, 1180.—T. F. B.

*Filtering medium* [*tile*]. U.S. Pat. 1,117,601. *See* I.

## IX.—BUILDING MATERIALS.

*Lime mortar; Strength of* ——. W. E. Emley and S. E. Young. Amer. Soc. Testing Materials, June 30—July 3, 1914. [Advance proof] pp. 21.

A LARGE number of cubes, briquettes, and bars were made from different sand-lime mortars under conditions as uniform as possible, and the effect of the following factors on the compressive and tensile strengths of the specimens were observed: age; size and shape of specimens; proportion of sand; consistence of mortars; condition of atmosphere as regards temperature, $CO_2$-content, and humidity; and chemical composition of the lime. The shearing strengths were compared by the use of a special instrument, adapted to grip a bar at both ends, whilst the part of the bar between the supports was sheared out by an equally distributed load. The results indicated that the strength of lime mortar was affected by too many variables to be capable of accurate measurement, and that no definite relation between the strength as measured in the laboratory, and that which might be expected in practice, could be established.—O. R.

*Cement; Errors in the methods of determining the time of setting of* ——. G. M. Williams. Amer. Soc. Testing Materials, 1914, **14**. [Reprint.] pp. 22.

IN tests made according to both Vicat's and Gillmore's methods, the results were found to be affected very considerably by the amount of work done on the material in the process of gauging, the humidity, and the temperature of the atmosphere during the setting period. Neither method yielded results which were sufficiently consistent and accurate for use as standards, except in the case of slow-setting cements.—O. R.

*Portland cement; Results obtained with the autoclave test for* ——. H. J. Force. Amer. Soc. Testing Mats., 1914. 6 pp. [Advance proof.]

NEAT cement even after exposure to the atmosphere for 18 months did not, in many cases, become sufficiently seasoned to pass the autoclave test, although showing considerable improvement in tensile strength. Most [American] cements, however, now show a tensile strength of 200—300 lb. per sq. in. with the autoclave test, whereas 2 or 3 years ago the majority exhibited little or no cohesion, many disintegrating entirely. An initially good tensile strength is always maintained. Results of tests are given in tables and curves.

—F. SODN.

*Portland cement concrete; Proportioning aggregates for* ——. A. Moyer. Proc. Amer. Soc. Testing Mats., 1914, **14**. 12 pp. [Reprint.]

THE ingredients are mixed in proportion to give maximum density, which the author considers necessary for securing maximum strength in the concrete. Thus, sand and cement mortar is made so that the voids in the sand (determined directly by mixing sand and water in known volumes) are completely filled with cement paste, every cubic foot of which requires 110 lb. of cement, and when stones of two sizes are used for the coarser aggregate, they are mixed in such proportion that a minimum volume is produced for a given combined volume before mixing. A table is given showing the percentage of voids in crushed stone (from material of 9 specific gravities, from 2·70 to 3·25) for a series of weights per cb. ft. ranging, in each case, from 80 to 124 lb., and another table showing the proportions of stone and mortar, for 11 different sand: cement ratios, necessary to give the densest concrete, when the coarse aggregate contains 27—54% of voids.—F. SODN.

*Concrete aggregates; Testing* ——. C. M. Chapman. Amer. Soc. Testing Materials, 1914. 6 pp. [Advance proof.]

SPECIMENS (6 in. cylinders or 2 in. cubes) are built up from the coarse aggregate previously coated with a cement grout, a sufficiently fluid standardised grout is poured in to fill completely the voids in the skeleton structure, and, after ageing the specimens are tested by crushing. Results are given showing that one stone may produce concrete 50—100% stronger than another, with the same proportion of the same sand and cement, the strongest concrete recorded being made from a light, porous material having a comparatively low crushing strength and a high percentage of voids.

—F. SODN.

*Rock asphalts of Oklahoma and their use in paving*. L. C. Snider. Petroleum, 1914, **9**, 974—976.

THE rock asphalts of Oklahoma contain 3—12% of bitumen and occur in deposits which are estimated, in some cases, to be capable of yielding 2·25—13·5 million tons of material suitable for paving. The proportion of bitumen is smaller than in "sheet-pavement" (an artificial mixture of sand, stone-dust, and bitumen), but the bitumen in the rock asphalt is not inferior in quality, and paving produced by rolling the heated material has proved superior to sheet-pavement in resisting penetration by traffic in hot weather.—F. SODN.

*Bituminous binders; Cementing value of* ——. L. Kirschbraun. J. Ind. Eng. Chem., 1914, **6**, 976—985.

THE cementing value of a binder is directly proportional to the work done in producing fracture or failure of a given unit of material. An apparatus is described by means of which strain is applied to a test-briquette of the material by a dynamometer travelling at an uniform speed, and the strain and elongation are measured. The briquette is drawn out until finally it either breaks, or the rate of elongation becomes higher than the rate of travel of the dynamometer, so that the value recorded by the latter pass through a maximum and then return to zero. Results obtained by the method with different materials are given in tables and diagrams. The cementing value is represented by the area enclosed by a curve plotted with

amounts of elongation as abscissæ and the values for the strain as ordinates; but the values for the elongation and the maximum strain must also be taken into account separately in estimating the value of a given material. In the case of bitumen for sheet asphalt pavements, it is recommended that when tested by the author's method, the minimum cementing value should be 0·08 kilogram-metre for light and 0·24 kilogram-metre for heavy traffic, with elongations of 8—14 cm. and 1—6 cm. respectively.—A. S.

*Production and uses of limestone in U.S.A.* Eckel. *See* VII.

PATENTS.

*Magnesium chloride composition and process of making the same; Dry* ——. L. H. Reuter, Berkeley, Cal. U.S. Pat. 1,117,443, Nov. 17, 1914. Date of appl., July 7, 1908.

MAGNESIUM sulphate (5 parts) is added to a dehydrated composition containing magnesium chloride and carbonate (preferably 100 and 20 parts respectively), the mixture is heated, calcined magnesite (over 250 parts) added, and the heating continued at a higher temperature. Or, a mixture of magnesium chloride and ground magnesite is evaporated practically to dryness, dry magnesium sulphate added (in amount at least sufficient to convert calcium hydroxide or oxide contained in the magnesite into sulphate), and the mixture is dehydrated by heating to a higher temperature and incorporated with calcined magnesite. The product is packed in air-tight containers.—F. SODN.

*Lime mortars, cements, etc., glazed or fire-enamelled, and their process of manufacture.* A. Bigot. Fr. Pat. 469,397, May 19, 1913.

MIXTURES of ground sand, quartz, granite, felspar, earthenware débris, etc., suitably selected, and bound together by fat lime, hydraulic lime, or by cements, either pure or mixed with magnesia, alumina, aluminates, and iron oxide, are enamelled or glazed, like ordinary ceramic products, either after a preliminary (biscuit) firing or in the raw state after the application in that case of coarse grains of a suitable engobe.—W. C. H.

*Wood; Bleaching* ——. A. Franck-Philipson. Fr. Pat. 469,296, Feb. 14, 1914. Under Int. Conv., Feb. 17, 1913.

SEE U.S. Pat. 1,068,580 of 1913; this J., 1913, 978.—T. F. B.

*Wood or like fibrous material; Treatment of* ——. F. W. Golby, London. From L. S. Bache, Bound Brook, N.J., U.S.A. Eng. Pat. 24,417, Oct. 28, 1913.

SEE Fr. Pat. 464,791 of 1913; this J., 1914, 551. —T. F. B.

*Cement; Process for lowering the temperature of burning and of manufacture of* ——. Brück, Kretschel und Co. Fr. Pat. 469,657, March 14, 1914. Under Int. Conv., March 16, 1913.

SEE Ger. Pat. 272,174 of 1913; this J., 1914, 551. —T. F. B.

*Bricks from the incombustible constituents of house refuse; Process for making red* ——. G. Hidoux and J. Bernheim. Fr. Pat. 469,771, March 19, 1914. Under Int. Conv., March 22, 1913.

SEE Eng. Pat. 7002 of 1913; this J., 1914, 82. —T. F. B.

*Process for utilising leather waste.* Fr. Pat. 469,779. *See* XV.

## X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

*Cast-iron car wheels; Standard specifications for* ——. Amer. Soc. Testing Materials. Yearbook, 1914, 242—247.

As an example of suitable metal the following analysis is given:—C (graphitic) 2·90, C (combined) 0·60, Si 0·70, Mn 0·40, P 0·50, S 0·08%; some of the constituents may vary within considerable limits. The data as to weight and tests are:—

| Wheel. | 33 in. diam. Freight and Passenger cars. | | | 36 in. diameter. | |
|---|---|---|---|---|---|
| Kind of service ..... | 60,000 lb. capacity and less. | 70,000 lb. capacity. | 100,000 lb. capacity. | Passenger cars. | Locomotive tenders. |
| Number ..... | 1 | 2 | 3 | 4 | 5 |
| Weight (lb.) { Desired | 600 | 650 | 700 | 700 | 750 |
| Weight (lb.) { Variation | 2% either way. | | | | |
| Height of drop (ft.) .. | 9 | 12 | 12 | 12 | 12 |
| Number of blows .... | 10 | 10 | 12 | 12 | 14 |

For any single inspection and test, only wheels having three consecutive shrinkage numbers (submitted by the manufacturer) will be considered. Wheels tested must show soft, clean grey iron free from defects such as holes, containing slag or dirt, more than ¼ in. in diameter, honeycombing of iron in the hub, white iron in the plates or hub, or clear white iron around the anchors of chaplets at a greater distance than ½ in. in any direction. The depth of the clear white iron must not be greater than ¼ in. at the throat and 1 in. at the middle of the tread, or less than ⅜ in. at the throat or any part of the tread. The blending of the white iron with the grey iron behind must be without any distinct line of demarcation, and the iron must not have a mottled appearance in any part of the wheel at a greater distance than 1⅛ in. from the tread or throat. The depth of chill, as regards each lot of 103 wheels, will be determined by inspection of three test wheels (all of which shall be broken for the purpose if necessary), and if one fails, all of the same shrinkage number in the lot shall be rejected, but the remainder may be re-offered in a subsequent lot. One of the test wheels, placed horizontally, flange downwards, on an anvil block (weighing not less than 1700 lb. and set on rubble masonry 2 ft. deep) having three supports not more than 5 in. wide for the flange to rest upon, shall be struck centrally upon the hub by a flat-bottomed weight of 200 lb. falling from the height indicated in the table; should the wheel be broken by a smaller number of blows than that shown in the table, the whole lot will be rejected. Each of the remaining test wheels shall be subjected to the following thermal test:—A channel, 4 in. deep and 1½ in. wide at the centre of the tread shall be moulded with green sand around the wheel placed (at ordinary temperature) flange downwards in the sand, the clean tread

forming one side of the channel and the clean flange part of the bottom. The channel shall then be filled to the top with molten cast-iron, the latter being poured from one ladle without previous cooling or stirring and at such temperature as to form, when cold, a ring of solid metal, free from wrinkles or layers, around the wheel. Two minutes after the pouring has ceased, each wheel shall be examined, failure as regards this test being indicated by fracture or by the extension, through or into the tread, of any crack in the plates. The lot will be accepted only if both wheels pass the test; but if one fails, only those of the same shrinkage number in the lot will be rejected, and the remainder may be re-offered in a subsequent lot.—W. E. F. P.

*Foundry pig iron; Standard specifications for* ——. Amer. Soc. Testing Materials. Year-book, 1914, 225—227.

To promote uniformity in grading, when any one or all of the constituents of pig iron are specified, the following percentages shall be used:—Si 1·00, 1·50, 2·00, 2·50, 3·00, 3·50 (0·25 allowed either way); S (max.), 0·04, 0·05, 0·06, 0·07, 0·08, 0·09, 0·10; total C (min.), 3·00, 3·20, 3·40, 3·60, 3·80; Mn, 0·20, 0·40, 0·60, 0·80, 1·00, 1·25, 1·50 (0·20 allowed either way); P, 0·20, 0·40, 0·60, 0·80, 1·00, 1·25, 1·50 (0·15 allowed either way). The standard methods of the American Foundrymen's Association shall be used for analysis, sulphur being determined gravimetrically unless otherwise specified. For market quotations a pig iron containing Si 2·00 (±0·25) and S 0·05% (max.) shall be taken as the basis; and a table is suggested to be used for adjusting disputes between buyer and seller, based upon the agreed price for the basis metal and a constant differential to be determined at the time the contract is made.—W. E. F. P.

[*Iron*] *locomotive cylinders; Standard specifications for* ——. Amer. Soc. Testing Materials. Year-book, 1914, 238—241.

THE cylinders shall be made from good quality close-grained grey iron cast in a dry mould. Drillings taken from the fractured ends of the transverse test bars shall contain P not more than 0·90 and S not more than 0·12%. Two arbitration test bars and one chill test shall be poured (in moulds of specified forms and dimensions) from each ladle of metal used for one or more cylinders. The arbitration test bars ($\frac{1}{8}$ in. smaller in diameter at the bottom than at the top), allowed to cool in the mould, shall have an average strength and deflection of not less than 3200 lb. and 0·09 in., respectively, when placed horizontally upon supports 12 in. apart and tested under a load applied centrally. The chill test bar, allowed to cool in the mould to a dark red (almost black) heat, then removed and quenched in water, shall, on being broken, show a fracture of close-grained, grey iron with a well defined border of white iron at the bottom; the depth of the latter shall not be less than $\frac{1}{16}$ in. as measured at the centre line.
—W. E. F. P.

*Steel; Standard specifications for methods of chemical analysis for plain carbon* ——. Amer. Soc. Testing Materials. Year-book, 1914, 169—176 and 181—192.

*Carbon* is determined by direct combustion in oxygen at 950°—1100° C., the boat or container for the metal being lined with alundum (90-mesh or finer). The oxygen employed (of not less than 97% purity) is passed over a heated catalyst (*e.g.* CuO) and through a purifying train before use. The carbon dioxide produced is absorbed in potassium hydroxide or soda lime and weighed as usual, or in a solution of barium hydroxide contained in a Meyer tube, the precipitated barium carbonate filtered off out of contact with the atmosphere, washed, dissolved in standard acid, and the excess of acid titrated with standard alkali; in the latter case no precautions are necessary to prevent access of water vapour or sulphur trioxide to the absorption tube.

*Phosphorus.* For routine work the steel is dissolved in nitric acid, potassium permanganate is added, then ammonium bisulphite to dissolve precipitated manganese oxide, the solution (at 80° C.) agitated with molybdate solution for 3—4 mins., the precipitate filtered off, dissolved in standard sodium hydroxide and titrated with standard nitric acid (see this J., 1912, 927).

*Sulphur.* In the oxidation method, the steel is dissolved in *aqua regia* and silica separated by two evaporations to dryness; the barium sulphate, precipitated by the addition of barium chloride to the cold hydrochloric acid solution, is allowed to stand for at least 24 hours, then filtered off, washed first with a hot solution containing 10 c.c. HCl and 1 grm. $BaCl_2$ per litre, until free from iron, and then with hot water. The washings are collected separately and evaporated to recover any dissolved barium sulphate. A blank determination is made on all the reagents used. In the evolution-titration method, 5 grms. of the steel are dissolved in 80 c.c. of hydrochloric acid (1 : 1) in a flask (480 c.c.) fitted with a stopper and thistle-funnel and having a straight side-tube with which is connected a vertical delivery tube extending to the bottom of a tall beaker containing 150 c.c. of water and 10 c.c. of ammoniacal cadmium chloride solution ($CdCl_2$ 10 grms., water 400 c.c., ammonia, sp. gr. 0·90, 600 c.c.). The flask and contents are heated until solution of the steel is complete, extremely slow or rapid evolution of gas being avoided, after which the solution is boiled for $\frac{1}{2}$ min.; the contents of the beaker are then acidified with 40 c.c. of hydrochloric acid (1 : 1), starch solution is added and the liquid titrated with a solution of potassium iodate ($KIO_3$ 1·116 grm., KI 12 grms., water 1000 c.c.) previously standardised against a steel of known sulphur content.

*Silicon.* The steel is dissolved in a mixture of nitric and sulphuric acids, or in the latter alone, the solution evaporated till sulphur trioxide is evolved and the operation concluded as usual, the silica obtained being evaporated with hydrofluoric acid. A blank determination is made on the reagents employed.

*Copper.* Solution is effected in sulphuric acid (1 : 4), the liquid diluted, heated, saturated with hydrogen sulphide, filtered, and the precipitate washed with 1% sulphuric acid containing hydrogen sulphide until free from iron; the filter and contents are incinerated, the residue fused with sodium bisulphate, the melt dissolved in hot water and the solution filtered, the copper being then determined colorimetrically (with ammonia or potassium ferrocyanide) or by electrolysis.

*Nickel.* The dimethylglyoxime method is employed, precipitation from the ferric solution being effected in the presence of tartaric acid. The precipitate is either dried at 110°—120° C. and weighed as such; or dissolved in nitric acid, the solution boiled with ammonium persulphate, cooled, made distinctly ammoniacal, silver nitrate and potassium iodide added, and the liquid titrated to a faint turbidity with a solution of potassium cyanide (2·29 grms. per litre) previously standardised against a steel of known nickel content.

*Chromium.* 5 grms. of the steel are dissolved in 50 c.c. of hydrochloric acid (1 : 1), the solution nearly neutralised with a saturated solution of

sodium carbonate and then completely with barium carbonate (10 grms. suspended in 100 c.c. of water) of which about 1 grm. excess is used. The precipitate, obtained by boiling the liquid in a covered flask for 10—15 mins., is filtered off, washed, the filter and contents incinerated, the residue fused for 10 mins. with a mixture of sodium carbonate (5 grms.) and potassium nitrate (0·25 grm.), the melt dissolved in water, 2 c.c. of hydrogen peroxide (3% solution) added, the liquid boiled and filtered. Chromium is determined in the filtrate (if strong yellow) by boiling thoroughly, acidifying with sulphuric acid, adding excess of standard ferrous sulphate and titrating the excess with standard potassium permanganate; or (if pale yellow) by colour comparison with a standard solution of sodium chromate.—W. E. F. P.

*Case-hardened carbon-steel objects; Recommended practice for the heat treatment of* ——. Amer. Soc. Testing Materials. Year-book, 1914, 207—208.

When hardness of case is the only important consideration, the carburised objects may be quenched either from the carburising temperature direct or, to minimise distortion and cracking, from slightly above the critical range of the case (800°—825° C.); both core and case remain coarsely crystalline as the result of either treatment. To refine and increase the toughness of the case, the carburised objects should be cooled slowly to 650° C. or below, then reheated to slightly above the lower critical point (generally between 775° and 825° C., according to the carbon content and thickness of the case) and quenched in water or oil but removed from the bath while still just above 100° C.; this treatment is most beneficial when the carburising temperature has not exceeded 900° C. To refine and increase the toughness of both core and case, the objects, slowly cooled to 650° C. or below, should be reheated to above the critical temperature of the core (generally 900°—950° C.), quenched, and, before they have cooled to below 100° C., reheated to slightly above the lower critical point of the case and again quenched in water or oil. As a final treatment the objects may be tempered by reheating to 200° C.

—W. E. F. P.

*Metals [iron and steel]; Standard methods for metallographic tests of* ——. Amer. Soc. Testing Materials. Year-book, 1914, 364—366.

*Microscopic examination.* Unhardened iron and steel, after polishing, should be examined under a magnification of 50 to 150 diameters, wrought iron for slag or cinder, steel for MnS, etc., and cast iron for size and shape of graphite. By etching for 15 secs. with a saturated solution of picric acid in alcohol, pearlite becomes darker than accompanying ferrite or cementite, and, in the case of wrought iron, the general appearance will sometimes show the origin of the material. Ferrite grains may be made visible by a rapid etching with nitric acid (1 vol.) diluted with water (9 to 3 vols.) or amyl alcohol (24 vols.). To distinguish between thin envelopes of ferrite and cementite near the eutectoid point (C 0·6—1·0%), the specimen should be etched at 100° C. with a solution of sodium picrate (picric acid 2, 25% caustic soda solution 98 parts) by which cementite becomes dark brown or black, other constituents being unaffected. The results should be compared with standard etched specimens. The indications for hardened and tempered steel are less decisive than the above; the 1% solution of nitric acid in amyl alcohol is recommended for etching, the time of which must be found by trial in each case. *Macroscopic examination.* For ascertaining the presence of defects due to segregation, blowholes, piping, etc., a polished section, washed with a strong solution of potassium hydroxide and rinsed, should be etched with (*a*) iodine solution (I 20, KI 30, water 1000 grms.), (*b*) dilute hydrochloric or sulphuric acid (up to 30% acid), (*c*) dilute nitric acid (from 1 : 9 to 3 : 7), (*d*) concentrated hydrochloric acid, or (*e*) copper ammonium chloride (10 or 12 parts of the double salt in 90 or 88 of water). The structure of wrought iron is "developed" rapidly by (*d*) and more slowly by (*c*) or (*b*); the segregation of carbon in steel is well shown by etching with (*a*) (5 secs. is enough for some materials), the impurities, segregation of MnS, slag, etc., being rapidly indicated by (*d*) although more accurately by (*b*). By etching very deeply, *e.g.*, for several hours with (*b*), the segregation of the carbon, and the impurities like slag and MnS are shown simultaneously, and a picture of the object may be obtained by inking and printing with the specimen.—W. E. F. P.

*Spelter; Standard specifications for [and analysis of]* ——. Amer. Soc. Testing Materials. Year-book, 1914, 284—287.

Virgin spelter (not re-worked metal) is considered in 4 grades, the maximum allowable impurities in which are:—

| Grade. | Maximum impurities per cent. | | | | |
|---|---|---|---|---|---|
| | Pb | Fe | Cd | Al | Pb + Fe + Cd |
| A. High grade .. | 0·07 | 0·03 | 0·05 | none | 0·10 |
| B. Intermediate .. | 0·20 | 0·03 | 0·50 | none | 0·50 |
| C. Brass Special .. | 0·75 | 0·04 | 0·75 | none | 1·20 |
| D. Prime Western | 1·50 | 0·08 | — | — | — |

To obtain the sample for analysis, at least 10 slabs from each car-load shall be sawn completely across and the sawdust collected, or the slabs drilled through and the drillings cut into short lengths; particles of iron are removed from the sample by means of a magnet before analysis:—*Lead.* Sufficient to be taken to contain at least 0·01 grm. of this impurity. *Iron.* At least 10 grms. of Prime Western, or 25 grms. of any other grade, to be completely dissolved in acid, the iron precipitated as ferric hydroxide, re-dissolved and determined volumetrically, as usual. *Cadmium.* 25 grms. to be treated with 330 c.c. of hydrochloric acid (1 : 5), allowed to stand over night and filtered (filtrate discarded); the insoluble residue (containing about 5% of the zinc) dissolved in nitric acid, 10 c.c. of sulphuric acid added, the liquid evaporated till sulphur trioxide is evolved, diluted and the lead sulphate removed by filtration; the filtrate is diluted to 500 c.c., 5 grms. of ammonium chloride is added, a slow stream of hydrogen sulphide passed through for 1 hour, the liquid allowed to stand for 5 hours and filtered; the precipitate washed with hot water, re-dissolved in 60 c.c. of boiling dilute sulphuric acid (1 : 5 by vol.), the solution filtered, diluted to 400 c.c. and saturated with hydrogen sulphide as before, the precipitated cadmium sulphide to be weighed as such or dissolved in hydrochloric acid and titrated with potassium ferrocyanide.—W. E. F. P.

*Manganese-bronze ingots for sand castings; Standard specifications for* ——. Amer. Soc. Testing Materials. Year-book, 1914, 288—289.

Composition to be Cu 53—62, Zn 36—45, Al 0·05—0·5, and Pb not more than 0·15%; ultimate tensile strength, not less than 70,000 lb. per sq. in. and elongation not less than 20%, as determined on a standard, turned specimen 0·5 in. in diameter and 2 in. gauge length.—W. E. F. P.

*Aluminium by electro-metallurgic methods.* J. Blanquier. Min. and Eng. World, 1914, **41**, 909—911.

THE bauxite used should contain less than 3% $SiO_2$. It is fused with sodium carbonate, or sodium sulphate and carbon, or heated in an autoclave under pressure with caustic soda, so as to form sodium aluminate, from which purified alumina is prepared by the action of carbon dioxide, or by agitating with freshly precipitated alumina. In the Serpek process, aluminium nitride is formed in an electric furnace, and decomposed with an alkaline solution to form sodium aluminate. In the Hall (American) process, the calcined bauxite is heated with carbon in an electric furnace, so as to form an alloy of iron with silicon, titanium, and aluminium, which is very dense and fluid, the purified alumina floating on it. In the furnaces for electrolysis of the alumina, carbon electrodes are used, the cathode forming the base in conductor furnaces, with 8 to 12 anodes, or both electrodes may dip into the electrolyte, some 30 to 40 electrodes being employed in four files, two of which are cathodes. Nearly pure cryolite may be used, or fluorides and sodium chloride may be added, so as to obtain a homogeneous electrolyte, fluid at 800° C., which will dissolve the maximum amount of alumina. The potential difference is usually 8 volts; it should not rise to 15 volts, the decomposition point of the cryolite. The current may vary between 8000 and 20,000 amps.—B. N.

*Uranium ores in Madagascar.* C. Grossmann. Comptes rend., 1914, **159**, 777.

A MINERAL has been discovered at Fiadanana, Madagascar, externally resembling euxenite and containing 12—40% $U_3O_8$. Its radioactivity, tested by an aluminium foil electroscope, is about double that of the pure oxide, thus suggesting an important source of radium.—W. F. F.

*Production and uses of limestone in U.S.A.* Eckel. *See* VII.

*Use of potassium permanganate as cyanicide in sand-filling solutions.* Cooper. *See* VII.

*Volumetric determination of copper in its salts and many of its alloys.* Zuccari. *See* XXIII.

PATENTS.

*Steel castings; Method of making sound* ——. L. B. Lindemuth, Steelton, Pa. U.S. Pat. 1,116,899, Nov. 10, 1914. Date of appl., April 11, 1914.

AN air-blast and ferrosilicon are applied to the surface of the molten casting until the latter has cooled sufficiently to prevent piping.—W. E. F. P.

*Manganese steel from scrap; Manufacture of* ——. H. M. Howe, Bedford Station, N.Y., Assignor to Taylor-Wharton Iron and Steel Co., High Bridge, N.J. U.S. Pat. 1,117,384, Nov. 17, 1914. Date of appl., May 16, 1912.

A MIXTURE of the scrap with ferro-manganese is melted, mixed with molten iron, and the product treated in an open-hearth furnace with manganese oxide or a slag in which the latter predominates over iron oxide.—W. E. F. P.

*Alloy steels; Process of producing* ——. B. D. Saklatwalla, Crafton, Pa. U.S. Pat. 1,119,643, Dec. 1, 1914. Date of appl., April 30, 1913.

A COMPOUND of the metal to be alloyed with the steel is reduced by ferrosilicon in presence of the molten steel.—O. E. M.

[*Iron ore, etc.*] *Briquettes; Method of making* ——. F. A. Jordan, Assignor to Moose Mountain, Ltd., Sellwood, Ont., Canada. U.S. Pat. 1,117,853, Nov. 17, 1914. Date of appl., April 30, 1914.

WET "ore-containing material" is charged into moulds formed by a framework resting upon a heated car. The car is placed in a drying chamber, until the briquettes have shrunk sufficiently to allow the frame to be removed, and the car is then transferred to a kiln in which the briquettes are hardened.—W. E. F. P.

*Electrolytically cleaning [metal] articles; Apparatus for* ——. E. Le Roy Couch, Hartford, Conn., U.S.A. Eng. Pat. 23,454, Oct. 16, 1913. Under Int. Conv., Jan. 31, 1913.

THE apparatus comprises a number of zones in each of which a liquid is contained and partly confined by steam jets arranged between the zones, the articles being passed continually through the zones, so that they are in contact during their passage with the metal of the apparatus. The articles are given a preliminary cleansing with brushes, and the further cleansing process in the apparatus is effected by the electrolytic action produced by contact of the liquid with the articles and a movable metallic belt which conveys them through the zones. A receptacle, adapted to contain liquid, is provided close to each of the zones, the liquid being pumped from the receptacles and heated, before being again discharged into the apparatus.—B. N.

*Flexible objects of organic origin; [Electrically] coating —— with metal.* R. Rafn, Nuremberg, Germany. U.S. Pat. 1,118,878, Nov. 24, 1914. Date of appl., Oct. 17, 1914.

METAL is disintegrated electrically *in vacuo* and deposited on the flexible base of organic origin, and the adherence of the coating is improved by superficially hardening a film of drying oil in intimate association with the base and the metal, any unchanged oil being afterwards removed. —B. N.

*Metal-melting apparatus.* W. I. Burch, London. Eng. Pat. 23,521, Oct. 17, 1913.

THE melting pot is provided with a perforated tray or dish and also with one or more stirring blades. The tray and the blades are moved up and down together and either or both are rotated. For example the blades may be fixed to, and the tray mounted loosely on, a sleeve having projections which engage with a spiral groove on a central pillar, so that when the sleeve is moved up and down, it and the blades are rotated relatively to the dish. (See also Eng. Pat. 15,323 of 1913; this J., 1914, 835.)—A. S.

*Melting of metal; Apparatus for regulating and controlling temperatures in the* ——. I. Hall, Birmingham. Eng. Pats. 26,583, Nov. 19, 1913, and 5198, Feb. 28, 1914.

IN apparatus of the type in which the temperature is controlled by means of a thermostat or differential expansion device connected with the gas-admission valve, the valve seating has an external screw thread which engages with a thread in the support for the seating. By turning the support the vertical position of the valve seating can be adjusted so that the gas-admission valve closes at any desired temperature within a definite range. —A. S.

*Fusion-furnaces; Process of generating heat in* ——. B. Stoughton, New York. U.S. Pat. 1,117,274, Nov. 17, 1914. Date of appl., April 8, 1912.

A BED of solid fuel is ignited in the furnace and atomised liquid fuel is then injected with only sufficient air to consume the latter completely and maintain a very slow combustion of the former.—W. E. F. P.

*Furnace; Heating and melting* ——. W. N. Best, New York. U.S. Pat. 1,119,227, Dec. 1, 1914. Date of appl., June 24, 1914.

THE furnace is fired by liquid fuel blown by an air blast through a laterally flaring jet extending along one side of the combustion-chamber.—O. E. M.

*Furnace; Electric* ——. W. H. Hampton, New York, Assignor to The Conley Electric Furnace Co., Inc., Wilmington, Del. U.S. Pat. 1,116,884, Nov. 10, 1914. Date of appl., Feb. 17, 1913.

THE reduction furnace comprises a shaft, which increases in width towards its base, and terminates in substantially vertical walls enclosing a space which forms a fusing and reducing zone above the hearth. Non-metallic heating bars of low conductivity are embedded in the vertical walls out of contact with the charge, and are arranged one above the other so that a differential heating effect may be produced. One or more substantially vertical walls, containing non-metallic heating conductors insulated from the charge, and spaced so as to permit free passage of the material, traverse the heating zone, with wide non-bridging spaces between the conductors.—B. N.

*Martin furnace.* Eickworth u. Sturm G. m. b. H. Fr. Pat. 469,859, March 19, 1914. Under Int. Conv., April 16, 1913, Jan. 24, and Feb. 19, 1914.

THE air enters obliquely on each side by a port narrowed at the exit, and mixes with the gas in a space in front of the hearth. The air conduits are also provided with outlets of smaller section which allow a portion of the air to pass directly to the roof of the furnace, thereby forcing the combustible gases downwards towards the metal.—T. ST.

*Furnace; Regenerative* ——. A. Pothmann. Fr. Pat. 470,068, March 26, 1914. Under Int. Conv., April 9, 1913.

THE furnace is designed to use blast-furnace gas which is burnt alternately at an end-on burner, and at one or more roof-burners situated nearer to the hearth. The burnt gases pass partly through the regenerators of the other burners, and partly through the furnace, exhausting direct to the chimney at the inlet end for the material to be heated. The flames thus pass alternately in opposite directions between the differently situated burners, and always in the same direction in the rest of the furnace.—T. ST.

*Concentrating tables for the treatment of ores and similar materials.* E. W. Wethercll, London. Eng. Pat. 27,149, Nov. 25, 1913.

THE table consists of long narrow parallel sections, alternating with troughs for tailings, so that dead space, with consequent waste of power in jigging, is avoided.—O. E. M.

*Ores; Concentrating* ——. H. L. Sulman and Minerals Separation, Ltd., London. Eng. Pat. 27,749, Dec. 2, 1913.

AQUEOUS extracts of nearly insoluble substances, such as tar-oils, are used as froth-producing agents in the agitation froth process for removing minerals from gangue.—O. E. M.

*[Sulphide] ores; Method of concentrating* ——. W. S. Stevens, Magdalena, N. Mex., Assignor to The Ozark Smelting and Mining Co., Cleveland, Ohio. U.S. Pat. 1,116,642, Nov. 10, 1914. Date of appl., Dec. 10, 1912.

THE crushed ore is mixed with water, sulphuric acid (5% or less of the weight of ore) and petroleum oil of high.b. pt. (1% or less), at not below 60° C., and the mixture is first "presented to the air" and then to the surface of a liquid, whereby flotation of the oiled sulphide particles is effected by surface tension.—W. E. F. P.

*Sulphide ores; Concentration of* ——. Minerals Separation, Ltd. Fr. Pat. 469,677, March 14, 1914. Under Int. Conv., April 3, 1913.

ORES, slimes, etc., containing blende and galena are concentrated by a flotation process in which the water is rendered slightly alkaline with sodium carbonate. The mixture is agitated and aerated, preferably at 48° to 55° C., and a frothing agent such as eucalyptus oil may be added. The concentrate rises in the froth, the gangue sinking to the bottom.—T. ST.

*Slime separator.* C. Allen, El Paso, Tex. U.S. Pat. 1,118,614, Nov. 24, 1914. Date of appl., Aug. 3, 1910. Renewed May 27, 1914.

THE sludge runs continuously into a conical tank with a float-controlled valve at the bottom to retain a constant quantity of sediment in the tank. The discharged sediment is carried off by a stream of water proportional to the quantity of solid matter.—O. E. M.

*Alloy.* C. R. Denton, Sheffield. Eng. Pat. 17,157, July 20, 1914.

NICKEL (7·5 lb.), vanadium (0·5 lb.) and copper (25 lb.) are melted together, and a further quantity (18 lb.) of copper is added. Then, in presence of a suitable flux, spelter (6 lb.), tin (3·5 lb.), and aluminium (0·5 lb.) are added successively, the melt being heated to about 2000° F. (about 1100° C.) after each addition. The alloy can be brazed, stamped, cast, rolled, hammered, etc., without losing its ductility, is not tarnished under ordinary conditions, and resists corrosion by sea-water and most acids.—A. S.

*Alloy and its manufacture.* V. E. Maillard. Fr. Pat. 469,743, May 27, 1913.

AN alloy containing 2 to 20% Ni is made by adding finely-divided nickel, in small portions, to silver heated at least to the melting point of nickel, and agitated. The silver may be partially replaced by copper. The alloy is suitable as the basis metal for gold-plated articles of jewellery, etc.—T. ST.

*Bronze; Method of manufacturing a new* ——. A. Schwob et Cie. Fr. Pat. 469,784, May 28, 1913.

ALLOYS of Cu-Pb, and Cu-Pb-Sn, in all proportions, are made by adding the lead, or the lead and tin, in small portions to a bath of molten copper, agitated and heated to such a temperature that it will not adhere to an iron rod dipped into it. —T. ST.

*Zinc from zinc-bearing refuse; Process for the extraction of* ——. R. R. Parish, Assignor to Chase Rolling Mill Co., Waterbury, Conn. U.S. Pat. 1,104,922, July 28, 1914. Date of appl., May 7, 1914.

THE refuse is gradually introduced into dilute sulphuric acid, which is agitated with compressed air and maintained at its original strength by the

addition of strong acid, so that a concentrated solution of zinc sulphate is ultimately produced. This is neutralised by refuse containing zinc oxide, and the solution is agitated with compressed, ozonised air to precipitate manganese and iron, filtered, and further purified by contact or agitation with metallic zinc.—W. E. F. P.

*Zinc ores; Process of smelting* ——. J. M. Hyde, Berkeley, Cal. U.S. Pat. 1,118,012, Nov. 24, 1914. Date of appl., Feb. 13, 1914.

THE ore is fed continuously, with a flux and a reducing-agent, into an externally-fired retort. The zinc distils off, and the waste products are continuously removed from below in a fused state.—O. E. M.

*Metals [zinc, etc.]; Process for the distillation of —— from fused slags, ores, etc.* W. Troeller. Fr. Pat. 469,862, March 19, 1914. Under Int. Conv., April 1, 1913.

REDUCING gases such as producer gas, are passed through the fused slags, etc., to which, if necessary, fluxes have been added. Volatile metals such as Bi, Sb, Sn, Zn, etc., distil over and are recovered as metals or oxides. Other metals which become reduced may be tapped off from under the slag. Where the heating gases come into contact with the charge it is protected from oxidation by a layer of coke.—T. ST.

*Metals; Apparatus for treating* ——. S. T. Wellman, Cleveland, Ohio. U.S. Pat. 1,116,772, Nov. 10, 1914. Date of appl., Aug. 18, 1911.

A MIXTURE of ore and flux, reduced and melted by electrical means in a chamber having a removable closure at the bottom, is transferred while molten to an adjacent chamber in which the treatment is completed by similar means.—W. E. F. P.

*Mercury; Process for extracting —— from its ores and other materials.* E. B. Thornhill, Gray Summit, Mo. U.S. Pat. 1,119,377, Dec. 1, 1914. Date of appl., Jan. 12, 1914.

THE mercury is precipitated by means of a metal such as aluminium from a solution made by treating the ore with a solution of an alkali sulphide and hydroxide.—O. E. M.

*Copper; Method of extracting —— from ores.* G. D. Van Arsdale, East Orange, N.J. U.S. Pat. 1,119,477, Dec. 1, 1914. Date of appl., May 16, 1912.

THE ore is leached with dilute sulphuric acid to yield a solution containing 10% Cu; sulphur dioxide is added to prevent polarisation, and the solution is electrolysed. To avoid precipitation of sulphides, only 80% of the copper is deposited. The spent solution is used for leaching fresh ore.
—O. E. M.

*Copper; Process of extracting —— from ores.* G. D. Van Arsdale, East Orange, N.J. U.S. Pat. 1,119,478, Dec. 1, 1914. Date of appl., Sept. 20, 1912.

THE ore is roasted with a sulphur compound before treatment as described in U.S. Pat. 1,119,477 (see preceding abstract).—O. E. M.

*Copper; Furnace for melting and refining* ——. W. S. Rockey, West New Brighton, H. Eldridge, Stapleton, and C. D. Clark, New York, Assignors to Metallurgical Research Co., New York. U.S. Pat. 1,119,540, Dec. 1, 1914. Date of appl., Dec. 26, 1913.

THE metal is melted in a chamber heated by the combustion gases from fluid fuel burnt in a separate chamber, and is protected from oxidation, while being poured, by a current of burnt gases.—O. E. M.

*Metallic [tungsten] wires and strips; Manufacture of* ——. J. Pintsch Akt.-Ges. Fr. Pat. 469,212, March 3, 1914. Under Int. Conv., Oct. 15, 1913.

TUNGSTEN or other wire, for incandescence filaments, etc., heated electrically to a temperature below that at which measurable recrystallisation takes place, is passed through a short spiral of wire heated to a bright white heat, at such a speed (determined experimentally) that the small crystals constituting the wire as first produced are all absorbed into one big crystal across the section surrounded by the spiral. An inert atmosphere is maintained around the heated portion of the wire.—T. ST.

*Ores and solid salts; Treatment of —— by electrolysis.* A. A. M. Hanriot. Fr. Pat. 469,516, May 22, 1913.

THE ore or salt is placed in a suitable electrolyte in contact with the cathode, and a current is passed. The substance is reduced and the metal takes the place of the original substance without passing into solution.—B. N.

*Tin oxide ores and roasted tin sulphide ores; Method of removing iron from —— by treatment with acid.* M. Chiapponi, R. Hesse, and G. von Rauschenplat. Fr. Pat. 469,928, March 21, 1914. Under Int. Conv., March 27, 1913.

THE ores are treated with reducing gases at 300° to 500° C. to reduce the iron compounds present as far as possible to ferrous oxide, whilst leaving the tin oxide unaffected. The mass is then leached with hydrochloric or sulphuric acid to dissolve the ferrous oxide, or the iron may be removed as chloride by heating to 400°—500° C. in a current of hydrochloric acid gas.—T. ST.

*Thomas steel or other analogous manganese steels: Process for making* ——. H. Naegell. Fr. Pat. 469,665, March 14, 1914.

SEE Ger. Pat. 265,843 of 1912; this J., 1913, 1159.
—T. F. B.

*Melting and alloying metals in vacuo; Furnace for* ——. W. S. Simpson, London. U.S. Pat. 1,118,820, Nov. 24, 1914. Date of appl., March 26, 1913.

SEE Eng. Pat. 12,067 of 1912; this J., 1913, 755.
—T. F. B.

*Metallurgical furnace.* H. Davison and L. C. Harvey, Battersea, Assignors to Morgan Crucible Co., Ltd., London. U.S. Pat. 1,118,534, Nov. 24, 1914. Date of appl., March 14, 1913.

SEE Eng. Pat. 6808 of 1912; this J., 1913, 492.
—T. F. B.

*Melting and mixing metals in vacuo; Apparatus for* ——. W. S. Simpson, London. Reissue No. 13,849, Dec. 15, 1914, of U.S. Pat. 1,015,091, Jan. 16, 1912. Date of appl., Sept. 16, 1913.

SEE Eng. Pat. 11,832 of 1910; this J., 1911, 1020.
—T. F. B.

*Metallic body; Process for coating a* ——. G. Cooper, Birmingham. U.S. Pat. 1,121,168, Dec. 15, 1914. Date of appl., May 12, 1913.

SEE Eng. Pat. 11,380 of 1912; this J., 1913, 664.
—T. F. B.

*Ores; Dry treatment of* ——. W. Buddeus, Charlottenburg, Germany. U.S. Pat. 1,121,226, Dec. 15, 1914. Date of appl., Feb. 5, 1914.

SEE Fr. Pat. 466,397 of 1913; this J., 1914, 599. —T. F. B.

*Zinc-lyes; Treatment of* ——. W. Buddeus, Charlottenburg, Germany. U.S. Pat. 1,120,683, Dec. 15, 1914. Date of appl., Nov. 26, 1913.

SEE Eng. Pat. 25,967 of 1913; this J., 1914, 644. —T. F. B.

*Roasting furnaces; Feeding apparatus for* ——. Nichols Copper Co. Fr. Pat. 469,272, March 6, 1914. Under Int. Conv., March 7, 1913.

SEE Eng. Pat. 3581 of 1914; this J., 1914, 926. —T. F. B.

*Furnace for roasting ores; Mechanical* ——. E. Dohet. Fr. Pat. 469,820, March 13, 1914.

SEE Eng. Pat. 7892 of 1913; this J., 1913, 1017. —T. F. B.

*Roasting furnaces; Rabbling shaft for* ——. Nichols Copper Co. Fr. Pat. 469,990, March 23, 1914. Under Int. Conv., March 24, 1913.

SEE Eng. Pat. 7471 of 1914; this J., 1914, 926. —T. F. B.

*Furnaces or cupolas; Electric* ——. W. N. Crafts. Fr. Pat. 469,520, Aug. 8, 1913.

SEE U.S. Pat. 1,070,017 of 1913; this J., 1913, 915.—T. F. B.

*Muffle furnaces.* E. Curran. Fr. Pat. 469,814, March 11, 1914. Under Int. Conv., March 12, 1913.

SEE Eng. Pat. 6165 of 1913; this J., 1914, 320. —T. F. B.

*Oxidising, reducing, or otherwise treating ores and other materials; Mechanism for* ——. F. von Schlippenbach, Stolberg, Germany, Assignor to Dwight and Lloyd Sintering Co., Inc., New York. U.S. Pat. 1,119,459, Dec. 1, 1914. Date of appl., Jan. 21, 1910.

SEE Eng. Pat. 29,779 of 1909; this J., 1910, 1392. —T. F. B.

*Sodium and other metals; Production of —— from compounds thereof by electrolysis.* R. J. McNitt, Perth Amboy, N.J., U.S.A. Eng. Pat. 29,987, Dec. 30, 1913. Under Int. Conv., Jan. 2, 1913.

SEE Fr. Pat. 466,205 of 1913; this J., 1914, 600. —T. F. B.

## XI.—ELECTRO-CHEMISTRY.

*Working up of the materials obtained by the electrolysis of the residual liquors from the manufacture of potash salts.* Dietz. *See* VII.

### PATENTS.

*Ozoniser [for sterilising, etc.].* B. R. B. von Tagueeff, Berlin. Eng. Pat. 27,258, Nov. 26, 1913. Under Int. Conv., Sept. 12, 1913.

THE object to be treated is placed between two condensers charged with an alternating current, so that it is subjected to the direct action of ozone and ionised air.—B. N.

*Condensers; Electrical* ——. G. Giles, Fribourg, Switzerland. Eng. Pat. 10,868, May 2, 1914. Under Int. Conv., July 3, 1913.

A PART or the whole of the armature of a condenser is formed of a layer of lead, projected on to a non-conducting glass surface by one of the usual processes for pulverising metals.—B. N.

*Gases; Electrical apparatus for effecting the chemical combination of* ——. C. C. Meigs, Charleston, S.C. U.S. Pat. 1,116,606, Nov. 10, 1914. Date of appl., Jan. 23, 1914.

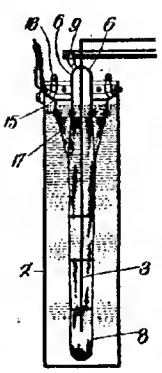
A STATIONARY outer shell is arranged within a vertical support, having a thrust-bearing element attached to its upper end. Contact brushes are connected with the outer shell, and extend towards the interior, where they engage with tubular contacts on an inner, closed rotating shell, so as to provide wide sparks. Several spaced hollow cooling members are arranged between the shells. A spindle connected with the upper end of the inner shell and passing through the outer shell and the thrust-bearing element, is provided with means for rotating it. A tubular spindle, connected with the lower end of the inner shell, rests at its lower end in a guide-bearing element, and gases are supplied through the latter to the inner shell.—B. N.

*Electrical separation; Process of* ——. H. M. Sutton, W. L. and E. G. Steele, Dallas, Tex. U.S. Pat. 1,116,951, Nov. 10, 1914. Date of appl., Jan. 11, 1908.

FINELY-DIVIDED material is separated by subjecting it to a convectively delivered electrical charge in the path of convection, thus causing some of the particles to adhere to an opposing electrode. The charge is varied in polarity and duration during delivery, according to the characteristics and susceptibilities of different particles of the material, and the separated particles are collected separately.—B. N.

*Electrolytic cell.* A. M. Griffin, Assignor to M. O. Hackett, Kansas City, Mo. U.S. Pat. 1,117,185, Nov. 17, 1914. Date of appl., April 27, 1914.

THE cell, 2, is made of conducting material, and is insulated from an inverted trough-shaped vessel, 6, supported within it, with its lower end submerged in the liquid. A sack, 8, insulated from and enclosing the anode, 3, is attached at its upper end to the lower end of the vessel, 6, and is provided with an inverted skirt, 17, which is flared outwards in an upward direction and attached to a frame, 15, secured to the cell around the vessel, 6. Pipes, 9, 18, which lead away the gases, communicate respectively with the interior of the vessel, 6, and with the space between the cell and the frame, 15. A series of cells may be used, the anode in each case being connected with the adjacent cell.—B. N.




*Electrolytic cell.* F. McDonald, Roaring Spring, Pa. U.S. Pat. 1,117,879, Nov. 17, 1914. Date of appl., April 20, 1914.

THE anode is enclosed in a perforated partition, closely surrounded by a porous diaphragm. A graphite cathode, the inner face of which is bevelled

at its upper end, is adjacent to but spaced from the diaphragm, and a column of mercury is interposed between and supported by the diaphragm and cathode. A decomposing element is arranged above the mercury column, between the upper ends of the cathode and the diaphragm, and means are provided for maintaining the solution in the cell at a constant level.—B. N.

*Insulating compounds.* J. F. Menningen, West Allis, Wis., Assignor to Allis-Chalmers Manufacturing Co. U.S. Pats. (A) 1,119,441 and (B) 1,119,442, Dec. 1, 1914. Date of appl., March 12, 1909.

(A) A MIXTURE of 5 parts of sand and hydraulic cement, 3 parts of asbestos, and 4 parts of shellac. (B) The sand in the above mixture is omitted, and a colouring matter is added.—B. N.

*Insulating electric conductors; Composition particularly suitable for* ——. T. J. Hadley, Winnipeg, Manitoba, Canada. Eng. Pat. 8138, March 31, 1914.

A MIXTURE of 8 galls. of coal tar, 2 galls. of kerosene oil, 2 galls. of Portland cement, and 1 gall. of japan drier.—B. N.

*Galvanic battery; Secondary* ——. H. P. R. L. Pörscke and J. A. E. Achenbach, Hamburg, Germany. U.S. Pat. 1,119,313, Dec. 1, 1914. Date of appl., April 22, 1911.

SEE Fr. Pat. 427,415 of 1911; this J., 1911, 1070. —T. F. B.

*Furnaces; Electric* ——. F. T. Snyder, Oak Park, Ill., U.S.A. Eng. Pat. 25,171, Nov. 4, 1913.

SEE Fr. Pat. 465,188 of 1913; this J., 1914, 491. —T. F. B.

*Removing liquid from organic and inorganic substances; [Electro-osmotic] process for* ——. B. Schwerin, Assignor to Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.), Frankfort, Germany. U.S. Pat. 1,121,409, Dec. 15, 1914. Date of appl., April 6, 1914.

SEE Eng. Pats. 6993 and 6995 of 1914; this J., 1914, 871.—T. F. B.

*Dehydration of organic and inorganic substances [by electro-osmosis].* Elektro-Osmose Akt.-Ges. (Graf Schwerin Ges.). Fr. Pat. 469,991, March 23, 1914. Under Int. Conv., June 21 and July 21, 1913.

SEE Eng. Pats. 6993 and 6995 of 1914; this J., 1914, 871.—T. F. B.

*Producing a bleaching, disinfecting, deodorising, or preserving agent.* Eng. Pat. 26,726. *See* VI.

*Separating the rare earths, together with thorium, cerium, and zirconium, by electrolysis.* U.S. Pat. 1,115,513. *See* VII.

*Treatment of ores and solid salts by electrolysis.* Fr. Pat. 469,516. *See* X.

*Composition particularly suitable for insulating electric conductors.* Eng. Pat. 8138. *See* XIII.

## XII.—FATS; OILS; WAXES.

*Raw linseed oil from North American seed; Standard specifications for the purity of* ——. Amer. Soc. Testing Materials. Year-book, 1914, 335—337.

THE oil shall have sp. gr. 0·936—0·932 at 15·5° C., or 0·931—0·927 at 25° C.; acid value 6·00 (maximum); saponification value 195—189; unsaponifiable matter 1·50% (maximum); $n_D$ 25° C., 1·4805—1·4790; iodine value (Hanus) 178. All tests should be made on the sample filtered through paper, at 60°—80° F. (15·5°—26·7° C.), immediately before weighing out; methods given in Bull. No. 107 (revised 1008) of the U.S. Dept. of Agriculture, Bureau of Chemistry, should be used for determining the acid, saponification, and iodine values, and Bömer's method for the unsaponifiable matter.—W. E. F. P.

*Linseed and petroleum oils; Iodine value of* ——. W. H. Smith and J. B. Tuttle. J. Ind. Eng. Chem., 1914, **6**, 994—998.

A DETAILED account of the experiments the chief results of which have been published previously (see this J., 1914, 700).—A. S.

*Grape-seed oil.* G. Dell' Acqua. Annali Chim. Appl., 1914, **2**, 295—301.

A SPECIMEN of grape-seed oil of undoubted purity had the following characters: Sp. gr. 0·9226 at 15° C.; Valenta test (critical temperature of solution in glacial acetic acid), 83° C.; refractometer reading (Zeiss-Wollny), 78·8 at 15° C., 62·9 at 40° C.; unsaponifiable matter, 0·325%; iodine value (Hübl), 140·25; thermal number (mixture of equal parts of sample and mineral oil in Tortelli's thermo-oleometer), 118° C.; acetyl value, 17·84; refractometer reading of acetylated oil, 76·7 at 19·5° C., 65 at 40° C. Fatty acids: sp. gr. 0·8988 at 25° C.; m. pt., 25°—28·5° C.; solidif. pt., 21°—18° C.; critical temperature of solution (5 c.c. of fatty acids, 10 c.c. of 70% alcohol), 75° C.; refractometer reading, 62·2 at 20·5° C., 50·8 at 42° C.; iodine value (Hübl), 141. The oil is very similar in properties to maize and soya bean oils, but the three oils may be distinguished by means of uranium nitrate (Settimi, Ann. del Lab. chim. centr. delle Gabelle, Roma, 1912, **6**, 461): 5 c.c. of the oil are shaken with 2 c.c. of chloroform and 3 c.c. of a 2% aqueous solution of uranium nitrate; maize oil gives a white emulsion; soya bean and grape-seed oils give an intense lemon-yellow colour. If 10 c.c. of the oil be heated on the water-bath with 3 c.c. of an ethereal solution of uranium nitrate, soya bean oil gives a yellow colour changing to olive green and red; grape-seed oil remains yellow for a longer time and then becomes orange-yellow. When heated for 10 mins. at 60° C. with nitric acid (Hauchecorne's reaction), soya bean oil gives a brownish-orange colour changing to chocolate brown, whilst grape seed oil gives a brownish to reddish orange colour.—A. S.

*Fats; Hardening [hydrogenation] of* ——. F. Bergius. Z. angew. Chem., 1914, **27**, 522—525.

DE HEMPTINNE has effected a partial conversion of oleic into stearic acid in an atmosphere of hydrogen in the absence of catalysis by passing the oil over plates charged at a high potential and between which there was a sparking discharge (see this J., 1905, 448). This process is more suitable for the polymerisation of mineral oils. Experiments by Kalnin in the author's laboratory have shown that hydrogenation is effected by heating oleic acid with alkali lye at 300° C. in hydrogen under a pressure of about 30 atmos. The process is independent of the purity of the oil or the hydrogen. The defective lathering properties of soaps from hydrogenated fats are now improved by the addition of liquid fats before saponification, whilst the proportion of nickel (which produces specks in the soap) is being continually reduced. Simultaneous hydrogenation and saponification, in the absence of catalytic agents, as described above, will probably prove a much cheaper process than

that in use, even after the expiry of the patent for the nickel process of hydrogenation in 1917.
—C. A. M.

*Fatty acids; Calcium and magnesium compounds of higher* ——. W. Haupt. Z. angew. Chem., 1914, **27**, 535—536.

THE magnesium salts of the higher fatty acids (palmitic, stearic, and oleic) are considerably more soluble in 0·025—0·1% solutions of sodium and potassium chlorides than in pure water. Hence the view that the introduction into rivers of magnesium chloride from potassium chloride works causes a very large waste of soap in towns where such water is used, is unjustified. Figures are given showing also that, per 100 grms. of metal, calcium chloride causes the precipitation of a much larger quantity of insoluble soap than does magnesium chloride.—F. C. T.

*Rapid determination of water in crude petroleum, oil fuel and similar substances.* Shrewsbury. *See* IIA.

*Revivification of bone-black.* Nagel. *See* XVII.

PATENTS.

*Cottonseed; Process for steritising and preserving* ——. E. R. Barrow, Assignor to Barrow Cottonseed Preserver Co., Memphis, Tenn. U.S. Pat. 1,119,672, Dec. 1, 1914. Date of appl., Nov. 18, 1913.

COTTONSEED is mixed with about 5% of finely divided sodium chloride and the mixture dried.
—C. A. M.

*Catalytic reactions; Process for carrying out* ——. [*Hydrogenation of oils.*] O. C. Hagemann and C. Baskerville. Fr. Pat. 469,172, Feb. 5, 1914. Under Int. Conv., Feb. 8, 1913.

SEE U.S. Pat. 1,083,930 of 1914; this J., 1914, 207. The catalyst may be in the form of very thin sheets of metal, the surface of which is partially oxidised. After the reaction, the catalyst is regenerated by treatment with air or other oxidising gas at a high temperature followed by treatment with hydrogen.—T. F. B.

*Lubricant; Electricatly-conducting* ——. G. Pommerhanz, Belvedere, Austria, Assignor to Standard Chemical Co., Bayonne, N.J. U.S. Pat. 1,118,148, Nov. 24, 1914. Date of appl., Nov. 21, 1913.

A METALLIC salt of a fatty or other organic acid is emulsified with a water-soluble oil and a solid thickening agent, with or without the addition of water, to obtain a lubricant of high electrical conductivity.—C. A. M.

*Oils; Process and apparatus for extracting —— by pressure.* H. Zander. Fr. Pat. 469,273, March 6, 1914. Under Int. Conv., March 8, 1913.

SEE Eng. Pat. 5706 of 1914; this J., 1914, 798.
—T. F. B.

*Fatty substances; Process for treating* ——. W. T. Powling, Prittlewell. U.S. Pat. 1,121,598, Dec. 15, 1914. Date of appl., March 29, 1913.

SEE Eng. Pat. 8397 of 1912; this J., 1913, 543.
—T. F. B.

*Rust-preventing greases and oils; Process for manufacturing* ——. B. Zschokke, Zürich, Switzerland. Eng. Pat. 28,283, Dec. 8, 1913. Under Int. Conv., Dec. 7, 1912.

SEE Ger. Pat. 276,122 of 1912; this J., 1914, 876.
—T. F. B.

*Oil-refiner.* U.S. Pat. 1,119,453. *See* IIA.

*Regeneration of impure benzine.* Fr. Pat. 469,490. *See* IIA.

## XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

*Pigments; Testing —— for permanence of colour.* W. de W. Abney. J. Roy. Soc. Arts, 1914, **63**, 85—94.

PIGMENTS fade very rapidly (in from 10 mins. to about 4 hrs.) when exposed to moist ozonised oxygen, but not in dry ozonised oxygen. The relative stability of pigments tested in this way is similar to their stability in light under atmospheric conditions. The stability of pigments, wall papers, dyed fabrics, etc., may therefore be rapidly tested by exposure in tubes to a current of moist ozonised oxygen, but oil paints have not given satisfactory results up to the present. Hydrogen peroxide was found to have no effect. Lists of stable and fugitive pigments are given. (See also this J., 1908, 1121; 1910, 705.)—R. G. P.

*Iodine value of linseed and petroleum oils.* Smith and Tuttle. *See* XII.

*Collodion enamels for leather.* Callan. *See* XV.

PATENTS.

*Metaltic paint; Manufacture of* ——. The British Patent Surbrite Co., and E. G. Meadway, London. Eng. Pat. 24,125, Oct. 24, 1913.

A WATERPROOF elastic paint is obtained by mixing an india-rubber solution with a metallic powder which has been rendered impervious to the rubber solution by being treated with a suitable substance such as a solution of shellac and gum mastic in methylated spirits and naphtha.—C. A. M.

*Lead; Process of oxidising* ——. C. D. Holley, Assignor to Acme White Lead and Color Works, Detroit, Mich. U.S. Pat. 1,116,702, Nov. 10, 1914. Date of appl., Feb. 11, 1911.

FINELY divided lead is exposed to the simultaneous action of alkali nitrate solution (*e.g.*, chromate waste liquor containing sodium nitrate) and air, and the resulting mass of "oxidised lead" and alkali nitrate is separated into its components.
—F. SODN.

*Basic carbonates of lead [white lead]; Process of making* ——. E. Euston, Assignor to Euston Lead Co., St. Louis, Mo. U.S. Pat. 1,117,358, Nov. 17, 1914. Date of appl., Nov. 2, 1911.

BASIC lead acetate solution is treated with carbon dioxide so as partially to precipitate the "basic portion," and, the greater part of the mother liquor having been removed, an acid lead acetate solution is added, and the mixture is treated with carbon dioxide until the proper density is acquired by the precipitate, which is then separated and finished. (See also this J., 1914, 363, 603.)
—F. SODN.

*Paint mixture.* Z. Bessette, Montreal, Canada. U.S. Pat. 1,116,977, Nov. 10, 1914. Date of appl., July 20, 1912.

A MIXTURE of oil and pigment forming a paint, to which is added an almost equal volume of lime-

water or an equal quantity of a mixture of benzine (2%), lime-water (97%), and colouring matter (1%).—F. Sodn.

*Zinc oxide; Separation of lead from* ——. 1. Tenenbaum. Ger. Pat. 276,776, Dec. 28, 1913.

Impure zinc oxide is freed from lead by treatment with 10% caustic alkali lye, and the solution thus produced is evaporated to a syrup, whereupon the greater part of the lead separates; on addition of water a solution of caustic alkali is obtained, together with a solid residue of oxygen compounds of lead.—T. F. B.

*Composition of matter [artificial amber] and process of producing the same.* L. V. Redman, Lawrence, Kans., Assignor to Amberoid Chemical Products Co., Chicago, Ill. U.S. Pat. 1,107,703, Aug. 18, 1914. Date of appl., Feb. 17, 1911.

A mixture of phenol or a homologue, hexamethylenetetramine (preferably 1 mol. to more than 5 mols. of phenol), an "initial product" solvent (which acts also as a controlling agent), such as denatured alcohol, acetone, or amyl acetate, and a small proportion of glycerin or the like, to give pliability to the product, is heated for a predetermined period at a comparatively low temperature, and the "initial product," thus obtained, is then heated more strongly under pressure. For example, 90 grms. of phenol is mixed with 3 grms. of glycerin, and 23 grms. of hexamethylenetetramine, 80 grms. of alcohol is added, and the mixture is heated at about 80° C. for 5 hours, after which it may be further heated at 130°—190° C., under 80—120 lb. per sq. in. pressure. Ammonia is evolved during the whole heating process. The final product, which is infusible, insoluble, and very inert, may be used as an artificial amber, insulating material, etc. The initial product may be used, without further treatment, as a varnish or adhesive. Dyestuffs may be added after the first heating.—F. Sodn.

*Plastic condensation product.* L. H. Friedburg, Assignor to General Electric Co., New York. U.S. Pat. 1,119,592, Dec. 1, 1914. Date of appl., Sept. 12, 1912.

A flexible insoluble, resinous, saponifiable product is obtained by heating a mixture of a polyhydric alcohol (glycerin), phthalic anhydride, and butyric acid until combination takes place, and distilling off the uncombined ingredients.—C. A. M.

*Rosin; Treating* ——. F. E. Mariner, Assignor to The Pensacola Tar and Turpentine Co., Gull Point, Fla. U.S. Pat. 1,117,584, Nov. 17, 1914. Date of appl., April 1, 1914.

Rosin, from which the turpentine has been separated, is distilled under reduced pressure (preferably of 22 inches, and at 290°—310° C.) until substantially all has passed over. A "grease-set" rich in abietic acid is obtained.—F. Sodn.

*Paint; Process for preparing a metallic* ——. A. Finkler and Co. Fr. Pat. 469,872, March 20, 1914.

See Eng. Pat. 8126 of 1914; this J., 1914, 1215.
—T. F. B.

*Condensation products from phenol and formaldehyde or other substances; Process for making* ——. K. Tarassoff. Fr. Pat. 469,832, March 14, 1914.

See Eng. Pat. 528 of 1914; this J., 1914, 557.
—T. F. B.

## XIV.—INDIA-RUBBER; GUTTA-PERCHA.

*Rubber used in nursing nipples and toys; Chemical composition of* ——. E. B. Phelps and A. F. Stevenson. U.S. Hygienic Lab., Bull. No. 96, Aug., 1914, 55—62.

Qualitative analyses were made of several varieties of nipples of black and red rubber, teething rings of red rubber, and toys of white rubber. The articles were decomposed by means of fuming nitric acid and ammonium persulphate. All the specimens contained iron and aluminium in considerable quantities, showing that clay had been used as a filling material. In the red rubbers ZnO and MgO were also present, and in the black rubbers ZnO and BaO. Antimony was found in several of the black and red rubbers. The white rubbers contained clay and ZnO. The samples containing antimony were digested in 0·5% solutions of lactic and hydrochloric acids for 5 days at 37° C. The amount of antimony dissolved from 6 grms. of the material varied from nil to 0·6 mgrm. Two of the red rubbers, which yielded most antimony to the acid solutions, were gently rubbed up in a mortar with fresh saliva acidified with lactic acid for 1½ hrs.: 0·2 and 0·6 mgrm. Sb respectively were dissolved. The use of rubber containing antimony in articles for infants is thus undesirable.—J. H. J.

*Rubber coagulant; Coconut water as a* ——. Chem. Trade J., Jan. 2, 1915.

The U.S. Consul at Colombo reports the successful use of coconut water as a rubber coagulant. Millions of gallons of coconut water now run to waste on estates in copra drying and desiccation mills. The "water" is allowed to ferment for four or five days, after which it can be used immediately for coagulating latex. One to two ounces of the fermented liquid will coagulate one pint of pure latex. It is said to produce a better rubber than that procured by using crude acetic acid, especially as regards colour.

### Patents.

*[Rubber] latex; Apparatus for treating* ——. H. A. Wickham. London. Eng. Pat. 2627, Jan. 31, 1914.

Apparatus for curing rubber by exposing successive films of latex to a treating agent such as smoke (especially that described in Eng. Pat. 7371 of 1907; this J., 1907, 1021) is furnished with a casing which more or less completely encloses the rotating member and which may be surrounded by a heating jacket. The casing is divided by a partition into two compartments, one of which communicates with a smoke furnace, whilst the other is largely isolated from the smoke and provided with an opening permitting access to the rotating member from without. The discharge end of the conduit, by which latex is conveyed from a reservoir to the rotating member, is given a reciprocating movement, so as to distribute the latex uniformly. The rotating cylinder is preferably vertical, but a modified form with flanged plate rotating in a horizontal plane is also described.
—F. Sodn.

*Caoutchouc substitute; Process of making* ——. O. Röhm, Darmstadt, Germany. U.S. Pat. 1,121,134, Dec. 15, 1914. Date of appl., Jan. 28, 1913.

See Eng. Pat. 613 of 1913; this J., 1913, 545.
—T. F. B.

*Rubber-covered [metal] article and method of making the same.* L. Daft, Rutherford, N.J., Assignor to Electro-Chemical Rubber and Manufacturing Co. U.S. Pat. 1,120,794, Dec. 15, 1914. Date of appl., June 3, 1910.

SEE Eng. Pat. 2306 of 1912; this J., 1912, 595.
—T. F. B.

## XV.—LEATHER; BONE; HORN; GLUE.

*[Chestnut oak and white] oak. Detection of —— in tannin extracts and leathers.* J. S. Rogers. J. Amer. Leather Chemists' Assoc., 1914, **9**, 525—537.

AQUEOUS extracts of chestnut oak when treated with a slight excess of ammonia show a decided blue fluorescence; the reaction may be used as a test for the presence of chestnut oak or white oak in other extracts, 10% of these oaks in a solution of any other tannin being easily detected.
—F. C. T.

*Moellon analysis; Report of Committee on ——.* T. A. Faust. J. Amer. Leather Chemists' Assoc., 1914, **9**, 548—562.

FOR moisture determination the method of direct heating in a wide platinum dish is quite accurate and distinctly better than the sand method. There was great diversity of opinion as to the determination of unsaponifiable matter; the following method is suggested for further discussion: 5 grms. of sample and 2·5 grms. of potassium hydroxide are dissolved in a little water, mixed with 25 c.c. of alcohol and heated under a reflux condenser for 1 hour. The soap is dissolved in 50 c.c. of hot water, the solution cooled, extracted three times with petroleum ether, and the extract washed three times with water. Two members of the Committee preferred to use ether instead of petroleum ether. The majority of the Committee preferred the method of Eachus (J. Amer. Leather Chemists' Assoc., 1913, **8**, 240) for the determination of oxidised fatty acids. One member preferred Lewkowitsch's method as easier of manipulation. The following method was suggested for the determination of free fatty acids and was found fairly satisfactory: 2 grms. of moellon are dissolved in a mixture of 20 c.c. of alcohol and 20 c.c. of ether which has been made neutral to phenolphthalein, and the free acids titrated with aqueous *N*/10 sodium hydroxide using phenolphthalein as indicator.

In the examination of hard greases, *e.g.* hard paraffin wax, and scale wax, the English and Saybolt methods proved equally reliable for the determination of melting point. For the estimation of free oil, the press method (Lewkowitsch, Vol. III., 215) proved the best. For other hard greases, the present method of carrying out the titer test (see Amer. Leather Chemists' Assoc. Official Methods) is regarded as satisfactory, as is the present method of determinating the acid value, with the substitution of *N*/10 aqueous sodium hydroxide for alcoholic potash. A method of determining unsaponifiable matter similar to that used for moellon, is regarded as best.—F. C. T.

*Collodion enamels for leather.* T. Callan. Leather World, 1914, **6**, 523—524.

COLLODION enamels for leather usually contain nitrocellulose; solvents, b. pt. 55° to 80° C., such as acetone, ethyl acetate and camphor dissolved in alcohol; solvents, b. pt. 110° to 160° C., such as amyl acetate and amyl formate; diluting agents such as petroleum hydrocarbons, benzine, and methylated spirit; softening agents such as castor or linseed oils; colouring matters. Enamels prepared with low-boiling solvents only will not give a coherent film on evaporation except in a warm dry atmosphere, as the rapid evaporation of the solvent cools the enamel, moisture is condensed from the air, and the nitrocellulose is precipitated as a white powder. The addition of a high-boiling solvent reduces the rate of evaporation, thus preventing surface cooling, and gives a brilliant film. With a nitrocellulose soluble in a mixture of camphor, alcohol, and benzene (90%), these solvents can be used as cheap diluting agents. The addition of castor or linseed oil makes the enamel more flexible but also softer and less durable, hence most of the oil should be in the lower coats. The colouring matters are usually pigments, but occasionally spirit-soluble dyes are employed.—T. C.

*Tannery waste; Disposal of ——.* A. Roth. J. Amer. Leather Chemists' Assoc., 1914, **9**, 512—522.

THE waste is first submitted to a sedimentation process, usually in a continuous flow tank, large enough to allow ample time for sedimentation, even with a maximum supply of liquor three or four times the average. The waste should enter the tank well below the surface and along the entire width, and should be drawn off over a weir and not though a single outlet pipe. Ample sludge storage should be provided, and deep tanks are preferable. Sedimentation may be made more efficient by the use of chemical precipitants such as lime or aluminium sulphate, or by utilising lime waste for the precipitation of tannins; the sludge after chemical treatment of the waste is sometimes very thin. The sludge is dried sufficiently by spreading it on well underdrained sand. For further treatment of the liquor some form of filtration is nearly always necessary, as sewage farming methods require too much land. Contact filters are inefficient and splinkling filters costly. Intermittent sand filtration has proved satisfactory, when sufficient time is periodically allowed for the aeration of the bed.—F. C. T.

*Tannery wastes; Sewage disposal and use of ——.* C. C. Smoot. J. Amer. Leather Chemists' Assoc., 1914, **9**, 523—525.

HAIR is washed and dried and in this form may be sold. Fleshings will yield 30% of grease; when they are limed for dispatch to glue factories about 8% will be found unsuitable, but may be treated for the recovery of grease. One half of the lime used in a tannery is taken up by the hide, 25% of the remainder goes into the sewage, and the remaining spent lime is useful in agriculture. Spent tanning materials are used as fuel, and the ash contains about 3% of potash. The sediment from waste liquors, spent lime, and ash from the tanning materials, form a useful fertiliser when used together.—F. C. T.

*Preparation and dyeing of skins.* König. *See* VI.

PATENTS.

*Skins; Process for treating ——.* La Peausserie Française. First Addition, dated Feb. 12, 1914, to Fr. Pat. 442,062, March, 1912 (this J., 1912, 890).

AFTER coating the skins with an adhesive solution as described in the chief patent, coloured fleshes, linen, silk, or metallic powders are applied.
—F. C. T.

*Skins; Process for puering* ——. L. Krall. Fr. Pat. 469,758, March 18, 1914.

As a substitute for dog-puer, a mixture is used containing lipolytic and proteolytic enzymes, substances capable of emulsifying the fats of the skin, and amino-acids.—F. C. T.

*Tanning materials; Process for producing* ——. Badische Anilin und Soda Fabrik. Fr. Pat. 469,359, March 6, 1914. Under Int. Conv., June 26, 1913.

AROMATIC hydroxy-compounds or their derivatives or salts of these compounds are treated under pressure above 100° C., with sulphites and formaldehyde, or with substances capable of generating these.—F. C. T.

*Leather-fibre board; Process for the production of* ——. A. L. Clapp, Braintree, Mass., Assignor to Hide-Ite Leather Co., Boston, Mass. U.S. Pat. 1,119,345, Dec. 1, 1914. Date of appl., Dec. 26, 1911.

TANNED leather waste is softened by treatment with chemicals that will produce chromic acid (*e.g.*, potassium bichromate and hydrochloric acid), and then beaten out in presence of a reducing agent (*e.g.*, sodium thiosulphate and hydrochloric acid) to reduce the chromic acid to chromic oxide.
—C. A. M.

*Leather waste; Process for utilising —— in the manufacture of "reconstructed" leather.* F. M. Loup. Fr. Pat. 469,779, May 28, 1913.

THE material is disintegrated by successive baths of warm sodium bicarbonate solution, acetic acid, and ammonia, followed by mechanical treatment. The product is compressed by hydraulic pressure, and may be used as a substitute for American fibre, wood for paving blocks, etc. The fibrous structure of the original leather is retained.—F. C. T.

*Leather; Waterproofing of chrome-tanned* ——. E. W. Terry, Hawthorn, Victoria. U.S. Pat. 1,121,418, Dec. 15, 1914. Date of appl., July 17, 1912.

SEE Eng. Pat. 16,060 of 1912; this J., 1913, 706.
—T. F. B.

## XVI.—SOILS; FERTILISERS.

*Phosphoric acid in soils; Strength of nitric acid, period of extraction, and ignition as affecting the gravimetric determination of* ——. O. L. Brauer. J. Ind. Eng. Chem., 1914, **6**, 1004—1005.

FOR the determination of the soluble phosphoric acid by extraction with nitric acid, the best results were obtained by digesting with 2*N* acid for 2 hours on the steam bath. The content of phosphoric acid soluble in nitric acid was diminished by igniting the soils.—A. S.

### PATENTS.

*Vinasse; Utilisation of —— as a fertiliser.* Melasseschlempe G. m. b. H. First Addition, dated Feb. 23, 1914, to Fr. Pat. 459,872, June 5, 1913 (this J., 1913, 1165). Under Int. Conv., May 30, 1913.

A NON-HYGROSCOPIC fertiliser is prepared by heating vinasse with superphosphate, *e.g.*, at 106°—108° C., until the free bases present have combined with the phosphoric acid, and the organic acids and water have been expelled.
—J. H. L.

*Treatment of seaweed for obtaining iodine and chemical by-products or fertilisers.* Fr. Pat. 469,324. *See* VII.

## XVII.—SUGARS; STARCHES; GUMS.

*Cane sugar factories; Advantages of the electrification of* ——. G. Lobo. Intern. Sugar J., 1914, **16**, 564—566.

NO cane sugar factory having a complete electric power plant has yet been erected, but in the Amistad Central factory, Cuba, steam power has been gradually replaced by electric power, and the advantages derived from the electrification of the grinding mills (each one driven independently by its own motor) are given as follows: The speed of each set of rolls may be varied in accordance with the percentage of fibre in the cane and the quantity of maceration water. Any one of the units may be stopped in the event of blockage without affecting the operation of the others. Neither the inertia of the moving parts (no heavy flywheel being necessary) nor the power of the motor is enough to cause breakage should a sudden resistance be encountered. The motors require little attention, and there is a considerable saving of labour; the cane is handled more quickly; the consumption of oil is decreased; the exhaust steam is free from oil, which is of importance in keeping the multiple-effect calandrias clean; and there is easier control of the plant and more complete centralisation of responsibility. Other parts of the factory than the milling plant have also been electrified, and the advantages that have ensued are:—The wages of engineers, attendants, and cleaners are more than 50% less and the total cost of manufacture about 15% less than with the steam drive. During the inter-campaign, the expense of the dismantling and preservation of the installation has been about half of what it was previously, the plant being furnished with a damp-proof insulation, which keeps it in good condition. On account of the longer life, the reduced cost of repairs, and the lower initial cost, depreciation and interest amount to about 15—20% less than those of a steam-driven factory of the same capacity. The total saving compared with a steam-driven factory of the most modern type is estimated as 20—25%.—J. P. O.

*Sugar solutions; Study of the efficiency of various methods for the filtration of* ——. A. E. Roberts. J. Ind. Eng. Chem., 1914, **6**, 986—989.

LABORATORY tests were made with cloth of varying degrees of fineness of texture, alundum, various kinds of filter paper, 40-mesh sand, asbestos, fullers' earth, infusorial earth, and sawdust. In all cases it was found necessary to defecate the sugar solution. Increasing the hydrostatic pressure proved a better means of accelerating filtration than the use of suction, increasing the filtering surface, or inverting the filter to keep it free from a deposit of solid matter. Rapid and clear filtration was most readily obtained with sawdust, and the use of this material or some form of wood waste is recommended for laboratory work and also in refineries, where its chief disadvantage would be the cost of evaporating the increased volume of sweet water produced in washing the sawdust, whilst its advantages are that it is cheap, easily washed, needs no filter-presses, and yields clear bright liquors in a minimum of time.—A. S.

## PATENTS.

*Sugar; Treatment or preparation of —— and apparatus for use therein.* E. Shaw, G. S. and G. R. Baker, London. Eng. Pat. 27,185, Nov. 25, 1913.

To prepare fine powdery sugar (so-called "aerated" or "amorphous" sugar) such as is referred to in Eng. Pats. 28,297 of 1903 and 4112 of 1904 (this J., 1905, 144, 245), the treated syrup is delivered on to a plate or surface the temperature of which can be controlled, and the layer of sugar so formed is removed and delivered into and through a chamber or trough wherein the heat is controlled so that the syrupy mass crystallises uniformly. From this chamber the sugar, air, and vapour are withdrawn by a fan at high speed, so that the sugar is subjected to an air blast of large volume which cools, dries, and delivers it for further treatment. Sugar dust remaining suspended in the air is recovered by moistening with a steam jet and water spray. —J. F. B.

*Locust beans; Process for obtaining —— in the form of a pure and dry powder from which gum can be made.* A. Pinel, Houlme, France. Eng. Pat. 13,508, June 3, 1914. Under Int. Conv., June 26, 1913.

LOCUST beans, previously decorticated, are crushed in the moist state, and the moist powder is dried and again crushed.—J. F. B.

*Adhesive substance from seaweed; Process for producing a light coloured ——.* Norsk Tangsyndikat. Fr. Pat. 469,191, Feb. 27, 1914. Under Int. Conv., March 1, 1913.

SEE U.S. Pat. 1,099,382 of 1914; this J., 1914, 840. —T. F. B.

*Process for the utilisation of marine algae.* Fr. Pat. 469,190. *See* VII.

## XVIII.—FERMENTATION INDUSTRIES.

*Barley; Proteins of —— in the grain itself and during the brewing processes.* H. Schjerning. Comptes rend. Trav. Lab. Carlsberg, 1914, 11, 45—105.

THE results of the author's previous work on this subject (see this J., 1906, 1109; 1910, 583; 1913, 985) are summarised and full details are given of the method of precipitation by solutions of metallic salts employed in determining different classes of proteins and their products of hydrolysis. The principle of this method is as follows:—Under the conditions described albumin I (leucosin) is salted out by stannous chloride; albumin I., albumin II. (edestin), and denuclein by mercuric chloride; albumins I. and II., denuclein, and proteoses (albumoses) by ferric acetate; albumins I. and II., denuclein, proteoses, and peptone (real peptone) by uranium acetate; albumins I. and II. and proteoses by magnesium sulphate. From the values thus obtained and the quantities of nitrogen, insoluble, soluble, and present as ammonia, the amounts of the various classes of nitrogenous compounds present in a liquid can be calculated. The probable course of protein degradation (and conversely of protein condensation) is represented by the following stages, taken in order:—Insoluble protein, albumin II, albumin I., peptic products (denuclein, proteose, peptone) and tryptic products (amides, amines, and ammonia).—J. H. L.

*Barleys; Ammoniacal nitrogen in ——.* H. Leberle and H. Lüers. Z. ges. Brauw., 1914, 37, 321—324.

BY distillation with calcined magnesia at atmospheric pressure ammonium salts are completely decomposed, acid-amides (asparagin) only slightly, and amino-acids (glycine) not at all. The quantities of ammoniacal nitrogen determined by this method and calculated as protein, in 40 samples of barley from various localities, ranged from 0·24 to 0·42%, and lower values were obtained by distillation with magnesia *in vacuo*. No general relation was observed between the amount of ammoniacal nitrogen and the place of growth of a barley, the fertilisers employed, or the manner of storage of the grain. Determinations of the protein in barley by Barnstein's method gave values only 0·19—0·36% lower than those calculated from the total nitrogen-content of the grain (factor 6·25), so that the nitrogenous matters of barley consist almost exclusively of proteins of high molecular weight.—J. H. L.

*Hops; Investigations on ——. IV. Determination of resins in hops.* J. Schmidt, O. Winge and J. P. H. Jensen. Comptes rend. Trav. Lab. Carlsberg, 1914, 11, 116—147.

VARIOUS methods for determining the bitter substances of hops (Briant and Meacham, this J., 1897, 702; Tartar and Bradley, this J., 1912, 403) have been based on the separation of the soft $\alpha$- and $\beta$-resins from the hard $\gamma$-resin, in the belief that the latter is not bitter and is therefore of no value in brewing. The $\gamma$-resin, however, assists in clarifying the wort by precipitation of albumins, and it also possesses a bitter flavour readily recognisable in solutions, *e.g.*, in dilute alcohol. Water in which the solid $\gamma$-resin has been boiled for some hours is distinctly bitter, and however often the operation may be repeated with fresh water the residue retains its bitter flavour when dissolved in dilute alcohol. The relative bitterness conferred on wort by boiling with the separate resins for the period usually employed in brewing, is approximately 10 : 7 : 4 for the $\alpha$-, $\beta$- and $\gamma$-resins respectively and all three promote clarification of the wort. The average proportions in which the three resins are present in hops are approximately 6%, 8%, and 2%, and the quantities of each corresponding to 1 c.c. of $N/1$ potassium hydroxide on titration are 0·32, 0·40 and 0·6 grm. respectively. From these data it is calculated that, as regards bitterness and [illegible]tre towards alkali, the total resins in hops behave as if they consisted wholly of $\beta$-resin, and therefore in the following method the assumption that 1 c.c. of $N/1$ potassium hydroxide corresponds to 0·40 grm. of total resins (cp. Lintner, this J., 1899, 178) permits an approximately accurate determination of the "bitterness value" of hops. The method is as follows:—30 grms. of hops are disintegrated in a meat mincing machine. The first 5 grms. are discarded and the remainder, amounting to about 15 grms. (some remaining in the machine), is mixed, and 5 grms. weighed out into a tared flask and dried in a vacuum at 35° C. for 24 hours to determine the moisture. The material is next treated with 150 c.c. of ether free from water and alcohol, shaken frequently during 1 hour, and filtered. The residue is washed thoroughly with about 100 c.c. of ether, using a wash-bottle with a fine jet, and the extract is titrated with $N/20$ potassium hydroxide solution in 93% alcohol, in presence of 6—8 drops of a 1% solution of phenolphthalein in 93% alcohol, until a red colour is produced which further addition of alkali does not intensify. One c.c. of $N/1$ potassium hydroxide corresponds to 0·40 grm. of resins. If the hops and the ether are not free from water high results are obtained owing to solution of hop tannic acids

The presence of 4·5% of moisture in the hops may increase the apparent content of resins by more than 1%. To recover the ether it is transferred after titration to a large bottle half filled with saturated brine, and passed through 5 such bottles in the course of 5 days, each being shaken twice daily. It is next distilled from a bath at 40° C., then dried for some daye with calcium chloride, and for at least 10 days with sodium, and finally distilled from a bath at 35° C. The materials used by the authors for 1000 analyses were: 74 litres of ether, 35 litres of alcohol, 600 grms. of sodium, and 12 kilos. of commercial calcium chloride. A bibliography of the subject is appended to the paper.—J. H. L.

*Hop boiling; Transformations during* ——. G. Jakob. Spezialmonatschr. ges. Brau- und Malz-Betriebeskontrolle, 1913, 1, 2, 21, 27. Z. ges. Brauw., 1914, **37**, 21.

A LOSS of bitter substances occurs during the ageing of hops or their storage in a warm place; drying at higher temperatures results in a still greater loss and also a darkening of colour. If hops are boiled with a protein solution, the latter becomes after a time less bitter and more deeply coloured the longer boiling is continued. The oxidation of certain constituents of the hops is also influenced by the protein. The intensity of the oxidation processes is much increased by predigestion of the hops in the protein solution at 75° C., and is also influenced by the concentration of the solution and the final temperature. The loss of bitter substances during the boiling of worts with hops may be diminished by coagulating the proteins, as far as possible before the hops are added, but Wiegmann found that a similar result is attained by intense agitation of the boiling wort. The author distinguishes between readily soluble "primary" bitter substances which are readily decomposed, and the less soluble "secondary" bitter substances of harsher flavour which are more stable. The satisfactory flavour of a beer depends on the presence of both kinds in certain relative amounts, and no system of hop extraction should be adopted which allows the proper balance to be disturbed by excessive decomposition of the less stable but more aromatic bitter substances. —J. H. L.

*Hop boiling; Jakob's views concerning transformations during* ——. D. Wiegmann. Allgem. Brauer- und Hopfenzeit., 1913, **53**, 2917. Z. ges. Brauw., 1914, **37**, 22.

THE darkening of protein solutions on boiling with hope, observed by Jakob (see preceding abstract), is due not to bitter principles but to hop tannins. A deeper colour is produced by hops free from bitter substancee than by normal hops. Jakob's solutions of "primary" bitter substances are only solutions of tannins containing small quantities of bitter principles. Non-coagulable proteins are entirely or almost indifferent towards the bitter substances during the boiling of worts. The process suggested by Jakob, of agitating the hops with water at 70°—80° C. in a Halut extractor for half an hour and then adding the lupulin extract to the wort separately, is attended with great loss of bitter substances. Jakob's work shows the importance for the brewery of hop tannins in a concentrated form.—J. H. L.

*Yeast; Autofermentation of* ——. M. W. Beijerinck. Livre Jubilaire Van Laer. Z. ges. Brauw., 1914, **37**, 223—224.

THE autofermentation of yeast is accompanied by the conversion of the glycogen in the cells into dextrose by the enzyme glycogenase. *Schizosaccharomyces Pombe*, which contains no glycogen, does not undergo autofermentation. All influences which injure yeast without killing it induce autofermentation; such influences are desiccation and subsequent moistening, high temperatures, soluble matters of the most diverse kinds which raise the osmotic pressure, and poisons and disinfectants. Pressed yeast undergoes slow autofermentation even at 30° C., but most rapidly at 48°—49° C., the whole of the cell glycogen disappearing in 3—5 hours at this temperature. The corresponding temperature for beer yeast is lower, and this difference provides a means of distinguishing the two kinds of yeast. Sodium chloride exerts its maximum acceleration on autofermentation in solutions of about 5% concentration and isosmotic solutions of the most diverse non-poisonous substances have approximately the same effect. Mannitol exerts its maximum action at concentrations of 13—15%. The proportion of glycogen in pressed yeast, calculated from the amounts of alcohol and carbon dioxide formed during autofermentation, is usually smaller than in the better top-fermentation yeasts. In presence of poisonous substances the quantity of carbon dioxide formed is always much less than corresponds to the glycogen present.—J. H. L.

*Yeast juice; Reduction of acetaldehyde by* ——. S. Kostytschew and E. Hübbenet. Z. physiol. Chem., 1913, **85**, 408. Z. ges. Brauw., 1914, **37**, 260.

THE reduction of acetaldehyde observed by Lebedew and Griaznow with yeast maceration juice, in absence of sugar, is confirmed when freshly prepared yeast juice is employed. Previous negative results are attributed to the use of juice which had been kept for 42 hours at the ordinary temperature. The fact that not only living yeast, but also all forms of permanent yeast ("*Dauerhefe*") and yeast juice hitherto prepared, are capable of reducing acetaldehyde, is in accordance with the theory propounded by Kostytschew for the fermentation of sugar. (See also this J., 1912, 553, 741, 1195; 1913, 207; 1914, 328.)—J. F. B.

*Yeast organism; The chemical fixation of substances in killing the —— by various chemical reagents. Disappearance of the substance from the solution.* T. Bokorny. Allg. Brau. u. Hopfenzeit., 1914, **54**, 541. Z. ges. Brauw., 1914, **37**, 243.

IN studying the killing of yeast cells by various bases, acids and dyestuffs, it was frequently found that the reagent was fixed by the cell substance. The combination leads to the death of the cell, an alteration of the constituent groups of the protein complex being produced which prevents the exercise of vital functions. The poisonous action of dyestuffs is doubtless due to their property of being absorbed by the protoplasm. Dyestuffs which are still capable of staining at extreme dilutions are also poisonous to micro-organisme at extreme dilutions. Some aniline dyestuffs are fatal at dilutions of 1 part per 100,000 or more. It is also possible that the dyestuff is absorbed without chemical combination, apart from the protoplasm, by the cellulose or cell walls.—J. F. B.

*Alcoholic fermentation. V. Proteolysis by permanent yeast ("Dauerhefe") in presence of zinc chloride.* S. Kostytschew and W. Brilliant. Z. physiol. Chem., 1913, **85**, 507. Z. ges. Brauw., 1914, **37**, 260. (See this J., 1914, 706.)

EXPERIMENTS were made at the ordinary temperature with dry permanent yeast prepared according

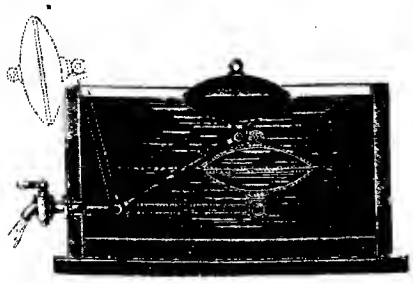
to Lebedew's method, containing total N 9·48% and protein N 7·62%. In absence of sugar, the addition of zinc chloride caused a slight increase of the proteolysis, which was apparently due simply to the acid reaction of the salt; in sugar solutions, on the other hand, there was a decided retardation. The inhibition increased with the concentration of the sugar, but was uninfluenced by increase in the quantity of zinc chloride, fermentative proteolysis being generally retarded by large proportions of sugar. The experiments proved that the powerful inhibition of zymase fermentation which is caused by zinc chloride is not due to the rapid destruction of the zymase by proteolysis, but is the direct effect of the zinc chloride on the activity of the fermentation enzyme.—J. F. B.

*Brewing practice; Sarcina-infection in —— and the degree of attenuation.* F. Stockhausen. Jahrb. Versuchs. Lehranst. für Brau., 1912, **15**, 305. Z. ges. Brauw., 1914, **37**, 270—271.

Two forms of malady in beers, due to sarcinæ, should be distinguished. In one the organisms, without any apparent change in the external conditions, multiply within a short time to such an extent as to render the beer turbid. In the other the beer assumes a light haze which may become more intense without forming any deposit, and as no sarcinæ, or only a few, are detected under the microscope the cause of the trouble may be overlooked. Incompletely saccharified worts are very subject to this malady, a great safeguard against which is a high degree of attenuation in the vat. It may sometimes be prevented by acidification of the mash, although in one case where this was successful the beer became cloudy with wild yeasts within a few days. Moreover the sarcinæ themselves produce acids and they readily become accustomed to high acidity and also to the use of large quantities of hops. Sarcina infection was exceptionally prevalent in the summer of 1911, and particularly in breweries with open surface coolers. Multiplication of the organism was favoured by the low attenuation of the beers of that year, which in turn was a consequence of overworking of the yeast owing to the highly nitrogenous malts employed. The chief safeguards against sarcina infection are pure yeast, rapid fermentation, and high attenuation.—J. H. L.

*Yeast; Automatic apparatus for drawing off wash waters from ——.* G. Fries. Z. ges. Brauw., 1914, **37**, 69—70.

THE yeast is suspended in water in the vessel shown (see figure) and strongly aerated, the float mean-



while resting against the side of the vessel. When the yeast has subsided the float is lowered on to the surface of the liquid, which enters the slot in the side of the float and is drawn off until the layer of yeast is reached, when the tap is closed. The apparatus can be taken to pieces for cleaning.

—J. H. L.

*Beer; New legislation respecting ——.* Finance Act, 1914 (Session 2) [5 Geo. 5, Ch., 7].

AN additional Customs duty is payable, from Nov. 18, 1914, on imported mum, spruce, or black beer and on Berlin white beer and other preparations of a similar character, at the rate of £4 0s. 10d. or £3 9s. 0d. per 36 galls. according as the original gravity does or does not exceed 1215. On other beers an additional duty of 17s. 3d. per 36 galls. of original gravity 1055 is imposed, with a rebate of 2s. until March 31, 1916, and afterwards of 1s. until March 31, 1917. A proportional rebate is also allowed off the additional Customs duty on the special kinds of beer mentioned above. Beer brewed for exportation may be placed in bond without payment of Excise duty, or if the latter has already been paid the brewer may obtain drawback on placing the beer in bond. For the determination of original gravity of beer worts a revised Table (see below) is substituted for the one hitherto used, and in calculating the duty a deduction of $\frac{3}{4}$ of a degree is allowed from the original gravities as shown by the Table. Samples of beer are to be filtered before distillation. Liquors made elsewhere than on licensed premises of a brewer shall not be regarded as beer unless their original wort gravity exceeds 1016 and they contain more than 2% of proof spirit.

*Table for determining the original gravity of worts of beer.*

| Spirit Indication. | Degrees of Original Specific Gravity. | Spirit Indication. | Degrees of Original Specific Gravity. | Spirit Indication. | Degrees of Original Specific Gravity. | Spirit Indication. | Degrees of Original Specific Gravity. |
|---|---|---|---|---|---|---|---|
| ·0 | ·00 | 4·1 | 17·75 | 8·2 | 36·58 | 12·3 | 56·38 |
| ·1 | ·42 | 4·2 | 18·21 | 8·3 | 37·04 | 12·4 | 56·89 |
| ·2 | ·85 | 4·3 | 18·66 | 8·4 | 37·51 | 12·5 | 57·40 |
| ·3 | 1·27 | 4·4 | 19·12 | 8·5 | 37·97 | 12·6 | 57·91 |
| ·4 | 1·70 | 4·5 | 19·57 | 8·6 | 38·44 | 12·7 | 58·42 |
| ·5 | 2·12 | 4·6 | 20·03 | 8·7 | 38·90 | 12·8 | 58·93 |
| ·6 | 2·55 | 4·7 | 20·48 | 8·8 | 39·37 | 12·9 | 59·44 |
| ·7 | 2·97 | 4·8 | 20·94 | 8·9 | 39·83 | 13·0 | 59·95 |
| ·8 | 3·40 | 4·9 | 21·39 | 9·0 | 40·30 | 13·1 | 60·46 |
| ·9 | 3·82 | 5·0 | 21·85 | 9·1 | 40·77 | 13·2 | 60·97 |
| 1·0 | 4·25 | 5·1 | 22·30 | 9·2 | 41·24 | 13·3 | 61·48 |
| 1·1 | 4·67 | 5·2 | 22·76 | 9·3 | 41·71 | 13·4 | 61·99 |
| 1·2 | 5·10 | 5·3 | 23·21 | 9·4 | 42·18 | 13·5 | 62·51 |
| 1·3 | 5·52 | 5·4 | 23·67 | 9·5 | 42·65 | 13·6 | 63·01 |
| 1·4 | 5·95 | 5·5 | 24·12 | 9·6 | 43·12 | 13·7 | 63·52 |
| 1·5 | 6·37 | 5·6 | 24·58 | 9·7 | 43·59 | 13·8 | 64·03 |
| 1·6 | 6·80 | 5·7 | 25·03 | 9·8 | 44·06 | 13·9 | 64·54 |
| 1·7 | 7·22 | 5·8 | 25·49 | 9·9 | 44·53 | 14·0 | 65·10 |
| 1·8 | 7·65 | 5·9 | 25·94 | 10·0 | 45·00 | 14·1 | 65·62 |
| 1·9 | 8·07 | 6·0 | 26·40 | 10·1 | 45·48 | 14·2 | 66·14 |
| 2·0 | 8·50 | 6·1 | 26·86 | 10·2 | 45·97 | 14·3 | 66·66 |
| 2·1 | 8·94 | 6·2 | 27·32 | 10·3 | 46·45 | 14·4 | 67·18 |
| 2·2 | 9·38 | 6·3 | 27·78 | 10·4 | 46·94 | 14·5 | 67·70 |
| 2·3 | 9·82 | 6·4 | 28·24 | 10·5 | 47·42 | 14·6 | 68·22 |
| 2·4 | 10·26 | 6·5 | 28·70 | 10·6 | 47·91 | 14·7 | 68·74 |
| 2·5 | 10·70 | 6·6 | 29·16 | 10·7 | 48·39 | 14·8 | 69·26 |
| 2·6 | 11·14 | 6·7 | 29·62 | 10·8 | 48·88 | 14·9 | 69·78 |
| 2·7 | 11·58 | 6·8 | 30·08 | 10·9 | 49·36 | 15·0 | 70·30 |
| 2·8 | 12·02 | 6·9 | 30·54 | 11·0 | 49·85 | 15·1 | 70·83 |
| 2·9 | 12·46 | 7·0 | 31·00 | 11·1 | 50·35 | 15·2 | 71·36 |
| 3·0 | 12·90 | 7·1 | 31·46 | 11·2 | 50·85 | 15·3 | 71·89 |
| 3·1 | 13·34 | 7·2 | 31·93 | 11·3 | 51·35 | 15·4 | 72·42 |
| 3·2 | 13·78 | 7·3 | 32·39 | 11·4 | 51·85 | 15·5 | 72·95 |
| 3·3 | 14·22 | 7·4 | 32·86 | 11·5 | 52·35 | 15·6 | 73·48 |
| 3·4 | 14·66 | 7·5 | 33·32 | 11·6 | 52·85 | 15·7 | 74·01 |
| 3·5 | 15·10 | 7·6 | 33·79 | 11·7 | 53·35 | 15·8 | 74·54 |
| 3·6 | 15·54 | 7·7 | 34·25 | 11·8 | 53·85 | 15·9 | 75·07 |
| 3·7 | 15·98 | 7·8 | 34·72 | 11·9 | 54·35 | 16·0 | 75·60 |
| 3·8 | 16·42 | 7·9 | 35·18 | 12·0 | 54·85 | | |
| 3·9 | 16·86 | 8·0 | 35·65 | 12·1 | 55·36 | | |
| 4·0 | 17·30 | 8·1 | 36·11 | 12·2 | 55·87 | | |

—J. H. L.

*Lactic acid; Production of —— by acetic bacteria.* A. Osterwalder. Centralbl. Bakt., 1913, II., 37, 353. Z. ges. Brauw., 1914, 37, 35.

CERTAIN acetic bacteria (*Bact. o aod r*) often produce appreciable amounts of lactic acid during the acetic fermentation, but only in presence of alcohol and probably from the latter either directly or secondarily from acetic acid. Malic acid is attacked by these bacteria but without formation of lactic acid.—J. H. L.

*Pyknometer spindle; The ——, a new instrument for alcohol determination.* H. Wüstenfeld and T. Foehr. Deut. Essigind., 1914, 18, 114, 125. Z. ges. Brauw., 1914, 37, 245.

FOR the rapid estimation of alcohol in vinegar factories by determination of the specific gravity, the ordinary hydrometer spindle is difficult to read accurately owing to the deformation of the meniscus by dirt on the surface of the liquid. In the new instrument the hollow portion of the hydrometer itself is filled with the distillate to be tested, after the manner of a pyknometer, and the instrument is floated in a liquid, *e.g.* toluene, which is unaffected by a greasy surface. In this way all the accuracy of a pyknometer is attained without the use of an analytical balance, and an observation may be made with a smaller quantity of distillate than is required to float a hydrometer spindle. The filling of the instrument is simpler than that of the pyknometer and adjustment to normal temperature is unnecessary if correction tables be used. The range of one spindle is from 0 to 12% of alcohol.—J. F. B.

*Denatured alcohol in Australia.*

A COMMONWEALTH Customs Order of Sept. 9, 1914, states that, owing to the difficulty of procuring spirit denaturants conforming to the prescribed standards, various General Orders hitherto issued are suspended until further notice. The denaturing of spirits for industrial purposes may be permitted by the use of denaturants of quality and quantity approved by the Collector of Customs; samples of the denaturants used will be tested periodically to ensure protecting the Revenue.

*Alcohol as a substitute for benzine for driving motor cars.* Hempel. *See* IIA.

*Substitutes for petrol and benzine in motor engines.* Dieterich. *See* IIA.

*Alcohol as a motor car spirit.* Mohr. *See* IIA.

PATENTS.

*Liquid [fermenting wort]; Apparatus for aerating and agitating ——.* H. J. Worssam, London. Eng. Pat. 26,591, Nov. 19, 1913.

AIR or other gas is led under pressure from a reservoir to nozzles attached to one or more arms submerged below the level of the fermenting liquid, the escaping gas being directed downwards and backwards so as to rotate the arms and at the same time agitate the substance (yeast) at the bottom of the containing vessel. A portable form of the apparatus with flexible hose connection to the agitator arms may be used.—J. F. B.

*Beer; Manufacture of temperance ——.* R. Wahl, Chicago, Ill. U.S. Pat. 1,117,613, Nov. 17, 1914. Date of appl., June 4, 1914.

BEER containing a low percentage of alcohol is prepared by adding to the wort an acid extract of the soluble matters of malt containing the peptase and the albuminoids dissolved by its action, together with the acid used for the extraction of the malt; adding yeast to obtain the fermentation flavour; cooling to near 0° C. to arrest alcoholic fermentation so that the alcohol does not exceed 0·5—1%, and causing the lactic acid to change the neutral phosphates of the wort to primary phosphates with sufficient additional acid to bring the amount of free lactic acid up to that contained in normal alcoholic beer.—J. F. B.

*Brewing [mashing]; Art of ——.* H. H. Freund, Weehawken Heights, N.J. U.S. Pat. 1,119,504, Dec. 1, 1914. Date of appl., April 3, 1913.

THE hulls are separated from the remainder of the malt body, treated with water to extract the deleterious ingredients, separated from this extract, and then added to the remainder of the malt body in the mash-tub.—J. F. B.

*Fermentation; Process of —— utilising the catalytic influences of stabilised electro-metallic colloids in combination with vegetable extracts.* R. Blum. Fr. Pat. 469,667, March 14, 1914. Under Int. Conv., April 1, 1913.

To stimulate the yeast and suppress fermentation by foreign organisms, the fermenting liquid is subjected to "radio-dynamic emanations" from an inert porous body, *e.g.*, clay, impregnated with known electro-metallic colloids and with vegetable extracts to confer the desired flavour and aroma on the product.—J. H. L.

*Wine; Manufacture of sparkling ——. [Treatment of bottles.]* H. Ebert. Fr. Pat. 469,674, March 14, 1914.

To enable bottles once used to be employed a second time without risk of breakage, they are heated to the softening point and cooled slowly. —J. H. L.

*Fusel-oil; Process of manufacturing ——.* J. Scheckenbach, Munich, Germany. U.S. Pat. 1,118,238, Nov. 24, 1914. Date of appl., Sept. 17, 1913.

SEE Fr. Pat. 462,472 of 1913; this J., 1914, 329. —T. F. B.

*Alcoholic fermentation; Process of ——.* R. de Fazi. Fr. Pat. 469,283, Jan. 19, 1914. Under Int. Conv., Jan. 28, 1913.

SEE Eng. Pat. 1335 of 1914; this J., 1914, 936. —T. F. B.

*Treatment [alcoholic fermentation] of sulphite cellulose waste lye.* Eng. Pat. 24,738. *See* V.

*Utilisation of vinasse as a fertiliser.* Addition to Fr. Pat. 459,872. *See* XVI.

*Manufacture of fatty acids.* Fr. Pat. 469,552. *See* XX.

## XIXA.—FOODS.

*Flour; Acidity of ——. Natural and artificial bleaching of flour, and sulphates and lime in flour.* R. T. Thomson. Analyst, 1914, 39, 519—527.

ORDINARY wheaten flour is neutral to litmus and methyl red, alkaline to methyl orange, and acid to phenolphthalein. The acidity as measured by titration, using phenolphthalein as indicator, is not due to lactic acid since this is also acid towards methyl red and litmus. When flour becomes

"sour" it is acid towards the two latter indicators, but it is doubtful whether, even in this case, the acidity is due to lactic acid.

During the process of milling, flour absorbs a certain quantity of nitrite from the atmosphere, the quantity being about 0·35 part (as $NaNO_2$) per million in the case of first-grade flour and decreasing as the product becomes coarser. The absorption of nitrites from the atmosphere by flour stored in glazed paper bags is very small, but the surface layer may absorb up to 3·12 parts per million, a quantity also found in flour which has been exposed for 30 mins. in a practically closed chamber containing lighted gas jets, or in that which has been artificially bleached with 3 c.c. of nitric peroxide per kilo. The percentage of colour destroyed, however, is entirely different, being only 6% in the case of the flour stored in the bag or exposed to the special atmosphere, whereas by the artificial bleaching 24% of the colour is removed. A specimen of flour bleached with 2 c.c. of nitric peroxide per kilo. contained 1·40 parts of nitrite per million and 7% of the colour was destroyed, whilst another specimen exposed to the air for 10 days and then found to contain 1·4 parts of nitrite, had 27% of its colour removed. The bleaching effect in the latter instance must be attributed to other causes than nitrous acid, probably oxidation assisted by moisture and light. Nitrites as such do not bleach flour, and the amount of acid required to bring flour into a condition capable of liberating nitrous acid from added nitrites is practically equivalent to the alkalinity of the mineral matter of the flour towards methyl orange; it is improbable that such a quantity of acid is present in the volume of air which could come into contact with the flour, and the author dismisses as impossible the theory that nitrous acid is the active agent in bleaching flour exposed to the atmosphere.

To determine sulphates in flour, 20 grms. is mixed with 250 c.c. of water containing about 15 c.c. of hydrochloric acid (sp. gr. 1·16), the mixture is heated on a boiling water-bath until the starch is liquefied, then boiled for a few minutes, cooled, filtered, and the insoluble portion washed with dilute hydrochloric acid. The sulphates in the filtrate are precipitated by barium chloride. First-grade flour was found to contian from 0·010 to 0·013% $SO_3$, and 0·015% CaO, whilst "common thirds" contained 0·061% $SO_3$ and 0·102% CaO (see also this J., 1914, 1069).—W. P. S.

*Iron in tomatoes.* C. A. Brautlecht and G. Crawford. J. Ind. Eng. Chem., 1914, **6**, 1001—1002.

TOMATOES grown in ten different counties of Florida, U.S.A., on soils containing 1·06—1·3% Fe, were found to contain 0·012—0·037% Fe (average 0·023). The water content of the tomatoes ranged from 89·3 to 95·3 (average 93·4) and the yield of ash from 0·38 to 0·64% (average 0·53). No relation between the water and ash, or iron and ash, could be detected, and the content of water and of iron appeared to be independent of the geographical position of the plot on which the tomatoes were grown.—A. S.

## PATENTS.

*Margarine; Manufacture of* ——. E. V. Schou, Copenhagen. Eng. Pat. 23,467, Oct. 16, 1913.

THE aqueous liquid and the fat are sterilised, and the former is then passed into a fermenting vessel where micro-organisms are developed under constant conditions throughout the entire liquid (see Eng. Pat. 4504 of 1912; this J., 1913, 444). The fermented liquid and the fat are passed into an emulsifier in the proportions it is desired to have in the finished product, and the emulsified mass is delivered between cooling drums and is instantly spread out into a layer sufficiently thin to secure uniform cooling throughout the entire thickness of the layer (see Eng. Pat. 12,561 of 1907). The whole process may be conducted out of contact with the outside air (see Eng. Pat. 4508 of 1912; this J., 1913, 446).—J. H. J.

*Flour; Dry-shortening* ——. A. W. Estabrook and H. E. Weaver, Kansas City, Mo., Assignors to The Larabee Flour Mills Co., Hutchinson, Kans. U.S. Pat. 1,119,260, Dec. 1, 1914. Date of appl., Nov. 6, 1913.

DRY flour is mixed with "a shortening amount" of powdered sodium stearate and gas-producing materials.—J. H. J.

*Tomato preserve; Manufacture of* ——. G. Frerichs. Fr. Pat. 469,255, March 5, 1914. Under Int. Conv., Mar. 23, 1913.

THE skins and seeds in tomato pulp are separated from the juice which is then fermented with yeast. After the fermentation is completed, the yeast is filtered off, and the filtrate is added again to the pulp. The mixture is evaporated to the desired consistence or to dryness.—J. H. J.

*Fodder; Manufacture of —— from waste sulphite-cellulose lyes.* J. Königs. Fr. Pat. 469,768, March 19, 1914. Under Int. Conv., Feb. 2, 1914.

WASTE sulphite lye is mixed with the residual liquid obtained in the treatment of wood with dilute alkalis and acids, with the aid of heat and pressure (see Ger. Pat. 265,483; this J., 1913, 1063), and the mixture is evaporated, neutralised, and freed from sulphurous acid; the product can be used as a cattle food. The sulphite lyes may be submitted to a preliminary treatment with acid or alkali, which enables them, after neutralisation and separation of sulphurous acid, to be evaporated separately; this product also can be used as a food by itself. The residual liquid obtained from the acid and alkali treatment of cellulose may be treated for the extraction of resins, tannin, sugar, etc., before being mixed with the sulphite liquor.—J. H. J.

*Food product; Manufactured —— and process of producing the same.* G. von Rigler, Kolozsvár, Austria-Hungary. U.S. Pat. 1,118,317, Nov. 24, 1914. Date of appl., May 22, 1913.

SEE Fr. Pat. 461,131 of 1913; this J., 1914, 215. —T. F. B.

*Tomato preserves, and process of making the same.* G. Frerichs, Bonn, Germany. U.S. Pat. 1,119,263, Dec. 1, 1914. Date of appl., March 19, 1914.

SEE Fr. Pat. 469,255 of 1914; preceding.—T. F. B.

*Vegetable extract similar to meat extract; Process for preparing a* ——. G. Frerichs. Fr. Pat. 469,373, March 7, 1914. Under Int. Conv., March 23, 1913.

SEE Ger. Pat. 269,813 of 1913; this J., 1914, 330. —T. F. B.

*Beverage extracts; Manufacture of* ——. J. L. Kellogg, Battle Creek, Mich. Reissue No. 13,847, Dec. 15, 1914, of U.S. Pat. 1,097,720, May 26, 1914. Date of appl., Oct. 22, 1914.

SEE this J., 1914, 803.—T. F. B.

*Desiccating organic matter.* U.S. Pat. 1,118,844. *See* I.

## XIXB.—WATER PURIFICATION; SANITATION.

*Oxygen in waters in presence of nitrite; Comparison of methods for the determination of* ——. E. Elvove. U.S. Public Health Service. Hygienic Lab., Bull. No. 96, 15—35, Aug., 1914.

THE Levy method, in which the amount of ferrous oxide oxidised is determined, gives low results even if nitrites are absent. The acetate modification of Winkler's method, in which potassium acetate is added before titration, affords more accurate results owing to depression of the dissociation of the nitrous acid (compare Hale and Melia, this J., 1914, 39). Excess of potassium acetate should be used, and 15 min. contact allowed. The permanganate modification of the Winkler method (Rideal and Stewart, this J., 1901, 841) gave very consistent results. When solutions of oxalic acid stronger than $N/50$ were used low results were obtained, but this could be counteracted by the use of more potassium iodide than usual. It is recommended that 0·45 grm. of potassium iodide be added, and that the excess of potassium oxalate should not exceed 1 c.c. of a 1% solution. The use of the permanganate method has the further advantage of oxidising the organic matter in the sample before the iodine is liberated.—J. H. J.

*Ultra-violet rays and their application for the sterilisation of water.* M. von Recklinghausen. J. Franklin Inst., 1914, **178**, 681—704.

THE only source of ultra-violet rays suitable for industrial purposes is the quartz mercury vapour lamp. With rays from such a source, a fraction of a second's exposure close to the lamp is sufficient to sterilise water. At a distance of 200 mm. from a lamp burning at 66 volts and 3·5 amps., many pathogenic and non-pathogenic bacteria in suspension in clean water were killed in 10—50 seconds; *Paramoecia* required 180 seconds and yeast 300 seconds. Spores were 1·5—5 times as resistant as vegetative forms. The sterilising action diminished as the square of the distance from the lamp, and was independent of temperature between 0° and 55° C. The power of the rays was determined by placing a drop of water containing *Paramoecia* at a definite distance from the lamp and observing the number of seconds required to kill them. A photochemical method was also used, the time taken to blacken silver citrate paper at different voltages being noted. The results by the two methods agreed very closely. Several forms of lamp are described, the one finally adopted to secure proper contact of the water with the rays being the closed U-shape, two of these being placed as radii in a circular tank. Ultra-violet rays not only kill bacteria, but also destroy toxins.—J. H. J.

*Shell fish; Investigation of coastal waters with special reference to the pollution of* ——. R. H. Creel. U.S. Hygienic Lab., Bull. No. 96, Aug., 1914, 5—14.

THE sewage of Gulfport, Miss., U.S.A., population 7000, is discharged into Mississippi Sound one mile from the shore. Between that point and the shore are oyster beds, and in most cases *B. coli* could be detected in 0·01 c.c. of the shell liquor. *B. coli* was invariably present in 0·01—1·00 c.c. of the sea water around the beds. The drainage from the cesspools of the town of Biloxi percolates into an arm of Mississippi Sound. The oyster beds are situated near the shore, and in nearly all instances *B. coli* was present in 0·01 c.c. of the shell liquor and in a few cases in 0·1—1·0 c.c. of the sea water.—J. H. J.

*Arsenic solutions [dipping baths]; Blood charcoal as a purifying agent for —— previous to titration.* R. M. Chapin. J. Ind. Eng. Chem., 1914, **6**, 1002—1003.

ARSENICAL dipping baths may be satisfactorily purified and decolorised previous to titration by digesting the acid solution with a small quantity of blood charcoal (not more than 0·25 grm. per 25 c.c.). In tests it was found that arsenious oxide was slightly adsorbed and oxidised by the charcoal but was again taken into solution on thorough washing. If total arsenious oxide is to be determined, the amount of arsenious oxide oxidised must be ascertained by a control determination with the charcoal used.—A. S.

*Calcium and magnesium compounds of higher fatty acids.* Haupt. *See* XII.

*Disposal of tannery waste.* Roth. *See* XV.

*Sewage disposal and use of tannery wastes.* Smoot. *See* XV.

PATENTS.

*Disinfectants and other chemicals; Appliance for mixing water with liquid* ——. W. S. Watson, East Sheen, Surrey. Eng. Pat. 26,918, Nov. 22, 1913.

Two pistons mounted on the same shaft work in the two compartments of a horizontal cylinder. One compartment communicates with the inlet for the chemical or disinfectant solution, and also with an outlet leading to a mixing chamber to which the water supply is also admitted. The other compartment communicates with a valve-chest and slide-valve, worked by the pressure of the water supply and admitting water to the two sides of the piston alternately; the pressure of the water entering behind the piston causes it to travel forward, and simultaneously causes the piston in the other compartment to move forward and eject the disinfectant into the mixing chamber. As the piston worked by the water pressure reaches the forward end, it engages a tappet rod connected with a lever, the movement of which reverses the water-supply valve.—J. H. J.

*Insecticide.* I. F. Peck, Auburn, R.I., Assignor to The Veldop Co., Wilmington, Del. U.S. Pat. 1,119,036, Dec. 1, 1914. Date of appl., March 7, 1914.

COMMERCIAL arsenic (one mol.) and slaked lime (2 mols.) are mixed together, a little free lime is added, and enough water to form a pasty mass. The product is capable of being mixed with larger quantities of water in which it remains in suspension so that it can be sprayed.—J. H. J.

*Refuse; Incineration of* ——. Müllverbrennungsges. m. b. H. "Vesuvio." Fr. Pat. 470,034, March 24, 1914.

THE refuse is fed into a hopper, at the bottom of which is a screw conveyor to feed it continuously on to the grate of the furnace. The furnace gases pass behind the grate, carrying the light cinders with them, whilst the heavy cinders fall into a bucket below the grate. The heat from the grate partially dries the refuse at the bottom of the hopper.—J. H. J.

*Soya beans; Process for making a soluble nitrogenous substance [decolorising agent] from* ——. E. Dammer. Fr. Pat. 469,787, Jan. 26, 1914.

SEE Ger. Pat. 274,974 of 1913; this J., 1914, 840. The product may also be used for treating boiler-feed water to prevent or remove incrustation.—T. F. B.

*Pasteurising liquids; Process of* ——. C. Krug, Frankfort on Maine, Germany. U.S. Pat. 1,119,520, Dec. 1, 1914. Date of appl., Dec. 12, 1913.

See Eng. Pat. 27,904 of 1913; this J., 1914, 710. —T. F. B.

*Purification of liquids; Process of and apparatus for the* ——. C. P. Landreth, Philadelphia. Eng. Pat. 2626, Jan. 31, 1914.

See Fr. Pat. 468,242 of 1914; this J., 1914, 971. —T. F. B.

*Filtering water and other liquids; Process and apparatus for* ——. L. Linden. Fr. Pat. 469,658, March 14, 1914. Under Int. Conv., Nov. 25, 1913.

See Eng. Pat. 1266 of 1914; this J., 1914, 938. —T. F. B.

*Household refuse; Process for separating —— into combustible fibrous matter and incombustible mineral matter.* G. Hidoux and J. Bernheim. Fr. Pat. 469,772, March 19, 1914. Under Int. Conv., March 22, 1913.

See Eng. Pat. 6998 of 1913; this J., 1914, 39. —T. F. B.

*Apparatus for indicating the presence and estimating the proportion of a gas [firedamp] admixed with air or other gases.* Eng. Pat. 26,001. *See* IIA.

*Producing a bleaching, disinfecting, deodorising or preserving agent.* Eng. Pat. 26,726. *See* VI.

*Ozoniser [for sterilising, etc.].* Eng. Pat. 27,258. *See* XI.

## XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

*Ragweed; Bitter principle of common* ——. B. E. Nelson and G. W. Crawford. J. Amer. Chem. Soc., 1914, **36**, 2536—2538.

Plants of *Ambrosia artemisifolia*, Linn. (N.O. *Compositae*), yielded a white crystalline substance, m. pt. 208° C., which appeared to be physiologically inactive, and a bitter amorphous substance, probably identical with absinthin derived from *A. absinthium*.—R. G. P.

*Solidago nemoralis; Volatile oil of* ——. E. R. Miller and M. H. Eskew. J. Amer. Chem. Soc., 1914, **36**, 2538—2541.

Ten samples of the plant yielded from 0·24 to 0·43%, mean 0·32%, of an olive green oil; optical rotation in 100 mm. tube, —14·82° to —17·73°. The chief constituent of the oil is α-pinene (mixed dextro- and lævo-modifications); acetic and salicylic acids, an alcohol existing free and combined as acetate, and, probably, borneol are also present (cf. Schimmel's Rept., April-May, 1906, 63). —R. G. P.

*Saccharin and sodium saccharinate [sodium sulphaminobenzoate]; Determination of* ——. U. Pazienti. Annali Chim. Appl., 1914, **2**, 290—294.

The purity of saccharin extracted in analytical work may be determined by titration with *N*/10 sodium hydroxide, using phenolphthalein as indicator. To control the purity of sodium saccharinate (sodium o-sulphaminobenzoate, $NH_2.SO_2.C_6H_4.CO_2Na$), the sodium may be determined as chloride; or saccharin may be precipitated from an aqueous solution of the salt by means of 6% hydrochloric acid, a correction being applied to allow for the slight solubility of saccharin (0·0403 grm. per 100 c.c.) in acid of this concentration; or a solution of the salt may be titrated with *N*/10 silver nitrate in presence of potassium chromate.—A. S.

*Addition compounds of sulphuric acid with organic substances.* Kendall and Carpenter. *See* III.

### Patents.

*Fatty acids, especially butyric acid; Process for manufacturing* ——. Soc. d'Etude du Carburx. Fr. Pat. 469,552, March 9, 1914.

Butyric fermentation is effected by suitable ferments (*Amylobacter*, *Clostridium*, etc.) which have been selected methodically, by successive cultures, to adapt their specific properties to the material to be treated. Two distinct types of ferment are used, to act on the one hand on the sugars, cellulose, amines, proteins, etc., and on the other hand on the amylaceous materials; these are chosen according to the materials to be fermented. In the treatment of sugar beets, the roots are made into a pulp with water, calcium or magnesium carbonate is added, and the mass is sterilised at 100° C. at least. When cool it is sown with about 10% of its volume of liquid from an operation already in progress; fermentation commences after a few hours at 38°—39° C., and this temperature is maintained during the entire process, which occupies from 8 to 15 days. The liquid is then filtered and concentrated in a multiple-effect apparatus until a saturated solution of calcium butyrate is obtained, at which stage the salt becomes insoluble at the boiling point; the calcium salts are separated from the liquid and decomposed by mineral acid, and the mixed fatty acids are fractionated to separate the butyric acid from the other acids formed. Sugar beets containing 18% of sugar will yield up to 12% of butyric acid by this process, indicating that the amino compounds and the cellulose have also undergone fermentation. From beet or cane molasses the yield of butyric acid amounts to 40—48% of the convertible substances.—T. F. B.

*Acetaldehyde from acetylene; Process for making* ——. Farbenfabr. vorm. F. Bayer und Co. Fr. Pat. 469,497, March 11, 1914. Under Int. Conv., March 15, 1913.

Acetylene is passed into a solution or suspension of an organic sulphonic acid and a mercury compound, or of a mercury salt of a sulphonic acid. In either case a free mineral acid may be added. For example, 21·6 parts of mercuric oxide is heated with 417 parts of *o*-chlorophenolsulphonic acid and 583 parts of water, and acetylene is passed into this solution at 30°—35° C.; when the absorption of the gas has diminished considerably, the aldehyde is removed by heating or by means of steam. The yield is about 300 parts. The solutions of sulphonic acids have a high power of hydratation, considerably greater than that of solutions of mineral acids of the same acidity.—T. F. B.

*Acetaldehyde from gases obtained by dry distillation of coal, lignite, peat, wood, etc.; Preparation of* ——. J. Behrens. Ger. Pat. 276,764, March 16, 1913.

The distillation gases are mixed with carbon dioxide and heated, whereby the ethylene is

converted into acetaldehyde; the aldehyde is removed as soon as it is formed, *e.g.*, by absorption with potassium bisulphite, since the reaction is reversible. Four to five vols. of carbon dioxide should be used to each volume of ethylene in the gases; greater excess results in the formation of carbon monoxide and water only. The yields amount to about 50% of the theoretical.—T. F. B.

*Liquid [acetic ester] which is an energetic solvent for many substances; Process for making a* ——. A. Helbronner and G. E. Criquebeuf. First Addition, dated May 30, 1913, to Fr. Pat. 464,646, Jan. 18, 1913 (see this J., 1914, 502).

The acetic acid present in dilute solutions is recovered in the form of an ester of low boiling point, by treatment with a suitable alcohol. This process may be applied to waste waters of paper works or vinegar factories, waste liquors from the manufacture of alcohol from cellulose, distillery vinasses, etc.—T. F. B.

*Derivatives of diaminodi[hydr]oxyarsenobenzene and process of making same.* G. Korndörfer and B. Reuter, Assignors to Farbwerke vorm. Meister, Lucius, und Brüning, Höchst on Maine, Germany. Reissue No. 13,848, Dec. 15, 1914, of U.S. Pat. 1,053,300, Feb. 18, 1913. Date of appl., Aug. 26, 1914.

See Ger. Pat. 245,750 of 1911; this J., 1912, 604.
—T. F. B.

*Arseno-azo compounds and process of making same.* P. Ehrlich and P. Karrer, Assignors to Farbwerke vorm. Meister, Lucius, und Brüning, Höchst on Maine, Germany. U.S. Pat. 1,120,700, Dec. 15, 1914. Date of appl., Feb. 2, 1914.

See Ger. Pat. 271,271 of 1913; this J., 1914, 502.
—T. F. B.

*Aliphatic aldehydes from gases obtained by the dry distillation of coal, lignite, peat, wood, etc; Preparation of* —. J. Behrens, and Norddeutsche Hütte Akt.-Ges. Fr. Pat. 469,582, March 12, 1914. Under Int. Conv., March 15, 1913.

See Ger. Pat. 276,764 of 1913; preceding.—T. F. B.

*Cocaine isovalerianate.* M. Overlach, Charlottenberg, and M. Körner, Berlin. Assignors to T. Teichgraeber, Berlin, and Saccharinfabrik A.-G. vorm. Fahlberg, List und Co., Salbke-Westerhüsen, Germany. U.S. Pat. 1,120,233, Dec. 8, 1914. Date of appl., Sept. 6, 1912.

See Eng. Pat. 10,750 of 1912; this J., 1912, 844.
—T. F. B.

*Water or other liquid; Method of rendering —— radio-active.* J. Landin, Stockholm. Eng. Pat. 2629, Jan. 31, 1914. Under Int. Conv., Feb. 10, 1913.

See Fr. Pat. 466,850 of 1913; this J., 1914, 864.
—T. F. B.

*Condensation and analogous processes.* E. I. du Pont de Nemours Powder Co. Fr. Pat. 469,405, March 9, 1914.

See Eng. Pat. 5408 of 1914; this J., 1914, 984.
—T. F. B.

## XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

*Photographic plates and cinematograph films; Anti-halo backings for* ——. S. Cocanari. Fr. Pat. 469,218, March 3, 1914. Under Int. Conv., Dec. 3, 1913.

Anti-halo backings for plates or films are made of an insoluble, indelible substance, of "actinic" colour, preferably deep blue or deep violet. It may be applied to the back of the support of the emulsion or interposed between the support and the emulsion. If it is undesirable to use a separate backing, the support itself may be coloured blue or violet.—T. F. B.

*Radiographic plates; Fluorescent —— and process of making them.* E. C. Saleil. First Addition, dated May 17, 1913, to Fr. Pat. 468,806, May 3, 1913 (see this J., 1914, 986).

The fluorescent film is detached from its support of glass or metal and coated on one side with a sensitive silver salt emulsion.—T. F. B.

*Photometry; Process of —— especially applicable to photography.* H. Goetz. Fr. Pat. 469,356, March 6, 1914. Under Int. Conv., March 8, 1913.

This process consists in measuring the diameter of the pupil of the eye when it is looking at the object in such a manner that at least half of the pupil receives directly the light from the object. In one form of the process, the observer sees in a mirror the image of his eye and also of a measuring scale, whilst in another form, a second observer measures the size of the pupil from its image in a mirror.—T. F. B.

*Photographic-printing process.* F. E. Ives, Woodcliffe-on-Hudson, N.J. U.S. Pat. 1,121,187, Dec. 15, 1914. Date of appl., July 12, 1912.

See Fr. Pat. 463,737 of 1913; this J., 1914, 441.
—T. F. B.

*Photography and cinematography in colours.* F. W. Donisthorpe. Fr. Pat. 470,176, March 27, 1914. Under Int. Conv., March 28, 1913.

See Eng. Pat. 7368 of 1913; this J., 1914, 503.
—T. F. B.

*Sensitive photographic paper and process of making the same. Process for the production of photographic prints.* W. Willis, Brasted Chart, Kent. U.S. Pats. 1,120,429 and 1,120,580, Dec. 8, 1914. Dates of appl., Sept. 22, 1913, and June 2, 1914.

See Eng. Pat. 20,022 of 1913; this J., 1914, 986.
—T. F. B.

## XXII.—EXPLOSIVES; MATCHES.

*Matches; Detection of white phosphorus in* ——. E. B. Phelps. U.S. Hygienic Lab., Bull. No. 96, Aug., 1914, 51—54.

About ten match heads are placed in a test-tube which is half filled with water and fitted with a rubber stopper holding inlet and exit tubes. The test-tube is placed in boiling water and a current of hydrogen, purified by passing through alkaline pyrogallol, is led through it for a few moments at a time. The exit tube is drawn out to a fine capillary, and is electrically heated by a coil of

wire to prevent condensation of moisture. The capillary end enters a dark chamber and is placed in the focus of a microscope of about 12 cm. focal length. A luminous jet at the tip of the capillary is evidence of the presence of yellow phosphorus. About 0·1 mgrm. of phosphorus in the quantity of match heads taken, can be detected. The presence of nitrates, chlorates, hydrogen sulphide, and carbon bisulphide does not interfere with the test.—J. H. J.

PATENTS.

*Explosive.* A. E. Charbonneaux. Fr. Pat. 469,752, March 18, 1914.

SEE U.S. Pat. 1,093,767 of 1914; this J., 1914, 569.—T. F. B.

*Explosives; Gelatinised propellant* ——. Nobel's Explosives Co., Ltd. Fr. Pats. 470,041 and 470,042, March 25, 1914.

SEE Eng. Pats. 4940 and 4941 of 1913; this J., 1914, 712.—T. F. B.

*Nitro derivatives of toluene; Process for making complex liquid* —— *especially applicable to the manufacture of explosives.* A. E. Vergé. Fr. Pat. 469,898, May 31, 1913.

SEE Eng. Pat. 17,128 of 1913; this J., 1914, 890.—T. F. B.

*Pyroxylin solvent.* U.S. Pat. 1,118,498. *See* V.

## XXIII.—ANALYTICAL PROCESSES.

*Methyl red as an indicator.* R. T. Thomson. Analyst, 1914, **39**, 518—519.

METHYL red gives a sharper end-point than methyl orange when the two indicators are tested in water with acid or alkali, and its sensitiveness, unlike that of methyl orange, is not greatly affected by the presence of neutral salts, such as sodium chloride or sulphate. When methyl red is used as the indicator in the titration of carbonates with acids, the solution must be boiled after each addition of the acid in order to expel free carbon dioxide. In general, methyl red most closely resembles litmus in its indications, but is to be preferred to the latter owing to its more decided change in colour with alkalis and acids.—W. P. S.

*Copper; Volumetric determination of* —— *in its salts and many of its alloys.* G. Zuccari. Annali Chim. Appl., 1914, **2**, 287—290.

THE solution of the copper salt is titrated with a solution of sodium nitroprusside (46·866 grms. $Na_2Fe(CN)_5NO,2H_2O$ per litre: 1 c.c. = 0·01 grm. Cu), the end point being ascertained by a spot test on filter paper with ammonium sulphide solution. The results are not affected by the presence of free acids or salts of Fe‴, Zn (unless in high concentration), Sn, Al, Pb, Mn, etc., and hence the method may be applied directly to solutions prepared from copper alloys not containing nickel or cadmium: any ferrous iron must be oxidised with nitric acid. The concentration of the solution should not be higher than 2—3%.—A. S.

*Water; Qualitative test for* —— *by the acetylene-cuprous chloride reaction.* E. R. Weaver. J. Amer. Chem. Soc., 1914, **36**, 2462—2468.

THE substance to be tested is brought into contact with calcium carbide in presence of a solvent of acetylene; the solvent is then decanted or distilled and tested for acetylene with ammoniacal cuprous chloride, a flocculent red precipitate of cuprous carbide indicating water. Nearly all the common organic solvents are suitable after careful desiccation; the calcium carbide is first freed from occluded acetylene by evaporating to dryness once or twice with a little anhydrous solvent. Two or three minutes contact of the carbide with the substance and solvent are sufficient, and it is preferable to employ a solvent which dissolves the substance tested. Cuprous chloride solutions prepared as described by Ilosvay (this J., 1899, 1158) are recommended. The only substances which interfere are the stronger acids and substances which react with cuprous salts, *e.g.*, hydrogen sulphide. The method is specially useful for detecting water in volatile organic liquids and is sensitive to less than 0·1 mgrm.—R. G. P.

*Determination of hydrogen in gas mixtures by means of colloidal palladium.* Burrell and Oberfell. *See* IIA.

*Determination of the viscosity of gas oils.* Hendrickson. *See* IIA.

*Rapid determination of water in crude petroleum, oil-fuel and similar substances.* Shrewsbury. *See* IIA.

*Test for toluene in benzol. See* III.

*Determination of the degree of bleaching of cellulose.* Schwalbe. *See* V.

*Determination of Prussian blue in cyanide mud.* Anderson. *See* VII.

*Determination of cuprous and cupric sulphides in mixtures of one another.* Posnjak. *See* VII.

*Modifications of the reduction test for tungstic acid.* Torossian. *See* VII.

*Standard specifications for methods of chemical analysis for plain carbon steels. See* X.

*Standard methods for metallographic tests of metals [iron and steel]. See* X.

*Standard specifications for [and analysis of] spelter. See* X.

*Detection of oak in tannin extracts and leathers.* Rogers. *See* XV.

*Report of Committee on moelton analysis.* Faust. *See* XV.

*Strength of nitric acid, period of extraction, and ignition as affecting the gravimetric determination of phosphoric acid in soils.* Brauer. *See* XVI.

*Determination of resins in hops.* Schmidt and others. *See* XVIII.

*The pyknometer spindle, a new instrument for alcohol determination.* Wüstenfeld and Foehr. *See* XVIII.

*[Determination of] sulphates in flour.* Thomson. *See* XIXA.

*Determination of oxygen in waters in presence of nitrite.* Elvove. *See* XIXB.

*Blood charcoal as a purifying agent for arsenic solutions [dipping baths] previous to titration.* Chapin. *See* XIXB.

*Determination of saccharin and sodium saccharinate.* Pazienti. *See* XX.

*Detection of white phosphorus in matches.* Phelps. *See* XXII.

PATENTS.

*Pyrometer; Absorption* ——. G. A. Alder and A. O. Cochrane, Middlesbrough, Yorks. Eng. Pat. 27,633, Dec. 1, 1913.

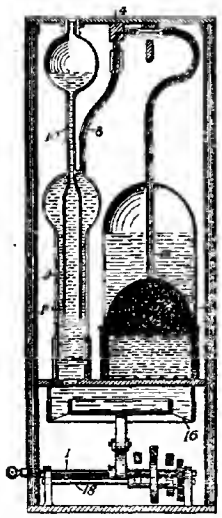
THE luminous rays from the hot body are focussed by a teleseope separated into two parts by a box containing the light-absorbing element. This may consist of a wedge-shaped glass container filled with a solution of one or more aniline dyes, or of a wedge of "neutral" glass. A compensating wedge of plain glass eliminates refraction. The absorption wedge is moved by a rack and pinion until the light is just cut off, a quadrant diaphragm assisting in the determination of this point. The position of the wedge as indicated on a scale is a measure of the temperature of the hot body. —W. F. F.

*Pyrometer; Optical* ——. A. C. Burleigh, Sewickley, Pa. U.S. Pat. 1,119,571, Dec. 1, 1914. Date of appl., Sept. 3, 1914.

A STRIP of metal through which an electric current passes, is surrounded by a glass cylinder, and a shield is provided within the cylinder having an opening through which the central part of the strip is exposed, and through which the heat tints produced on the strip can be seen.—W. F. F.

*Gas analysis; Apparatus for automatic* ——. H. J. Westover, New York. U.S. Pat. 1,111,815, Sept. 29, 1914. Date of appl., July 16, 1909.

THE apparatus (see fig.) is particularly adapted for the determination of carbon dioxide in furnace gases. The various parts are operated automatically by a system of levers and cams connected with the shafts, 1, and 18, the latter being geared to the shaft, 1, so that it turns once for every two turns of the latter. As the flexible diaphragm, 16, descends, the gas is drawn from a storage vessel through the distributing header, 4, and rubber tube, 8, into the measuring chamber, 9, any excess being expelled to the atmosphere through the tube, 10. The diaphragm, 16, then rises and when the liquid reaches the tube, 10, the gas-inlet tube is closed, and a measured quantity of the gas is trapped in the vessel, 9. Further rise of the diaphragm, 16, expels the gas into the reagent chamber, 25, containing some steel sponge to increase the effective surface of the absorbing liquid. The diaphragm, 16, now descends and the unabsorbed gas is drawn back into 9 and measured. The diaphragm on again rising expels the residual gas through the tube, 8, to a liquid seal (not shown) of such depth that the gas pressure is sufficient to displace also the spent reagent from the absorption chamber.—W. F. F.




*Apparatus for indicating the presence and estimating the proportion of a gas [firedamp] admixed with air or other gases.* Eng. Pat. 26,001. *See* IIA.

*Process of photometry.* Fr. Pat. 469,356. *See* XXI.

## * New Books.

[The Roman numerals in thick type refer to the similar classification of abstracts under "Journal and Patent Literature" and in the "List of Patent Applications."]

**I.** *Smith*, R. H.: Boilers, economisers and superheaters: their heating power and efficiency. Royal 8vo, pp. 136. C. Lockwood, London. 1914. Net 7s. 6d.

*Wells*, G. J. and *Tayler*, A. J. W.: The Diesel or slow-combustion oil engine. 2nd ed., revised. 8vo. pp. 320. Lockwood. 1914. Net 7s. 6d.

**IIA.** *Cooper-Key*: A primer on the storage of petroleum spirit and carbide of calcium. Phil. Lippincott. c. 128 pp. 12mo. 1914. $1 net.

**X.** *Gowland*, W.: The metallurgy of the non-ferrous metals. Phil. Lippincott. 296 pp. ill. pls. 8vo. 1914. $5 net.

*Heat-treatment of steel*: A comprehensive treatise on the hardening, tempering, annealing and case-hardening of various kinds of steel, together with chapters on heat-treating furnaces and on hardness testing. N.Y., Industrial Press. c. 10+278 p. Diagrams. 8vo. 1914. $2.50.

*Wagner*, F. H.: Cleaning of blast-furnace gases. 16½ pp. ill. diagrs. (1 fold.). 8vo. McGraw Hill, N.Y. 1914. $2.

**XI.** *Watts*, O. P.: Laboratory course in electrochemistry. 148 pp. ill. 16mo. McGraw Hill, N.Y. 1914. $1.

**XIXA.** *Ernst*, De W.: Text-book of milk hygiene. Royal 8vo. Baillière. London. 1914. Net 15s.

*Sherman*, H. C.: Food products. 9+594 pp. ill. Macmillan, N.Y. 1914. $2.25.

**XIXB.** *Hubbard*, C. L.: Heating and ventilating plants. 2nd ed. 300 pp. 8vo. McGraw Hill, N.Y. 1914. $2.50.

*Price*, G. M.: The modern factory: safety, sanitation and welfare. 8vo. Chapman & Hall. London. 1914. Net 17s.

**XXI.** *Namias*, R.: La fotografia a luce lampo. Casalmonferrato. 16° fig., p. viii, 136, con 16 tav. 1914. Lire 2.50.

*Namias*, R.: Teoria e pratica della coloritura delle fotografie ed ingrandimenti di ritratto e paesaggio. Casalmonferrato, 16°. p. vii, 112. 1914. Lire 2.50.

**XXIV.** *Fowle*, F. E., jr. comp.: Smithsonian physical tables. 6th rev. ed. Wash., D.C. Smithsonian Inst. 36+355 p. O. 1914. $2.

*Moore*, F. J.: Outlines of organic chemistry. 2nd ed. Cr. 8vo. Chapman & Hall, London. 1914. Net. 5s. 6d.

* Compiled by H. Grevel and Co., 33, King Street, Covent Garden, London, W.C., from whom all the works in the preceding list can be obtained.